

PLANT SCHOOL

SEATTLE WASHINGTON

PANEL MACHINE EQUIPMENT

LESSON NO. 1

SUBJECT

DESCRIPTION OF SYSTEM

LESSON NO.1

DESCRIPTION OF SYSTEM.

This lesson is designed to give you a simplified explanation of the new panel machine switching apparatus. We are trying to picture the equipment in familiar terms so that all may readily grasp its principle before approaching the details of methods, circuits and operations. A manual subscriber at East 0249 is supposed to be calling West 3496. The routing of this call is described using both manual and panel machine switching equipments so that you may follow the routing of a call through the two equipments.

"Panel Machine Switching Equipment" is the descriptive name given to telephone apparatus manufactured by the Western Electric Company Inc., to replace what is generally known as the "Manual Equipment".

The difference between a manual exchange and a machine switching exchange is that the latter performs the work of the operator by mechanical means. To understand how this is done, it is necessary to familiarize one's self with the equipment which replaces the operator and it is well to remember that these mechanical functions are obtained by the addition of only eight principal pieces of apparatus. The balance of the equipment is identical, or quite similar to that now used in large manual exchanges.

OFFICE LAYOUT

The appearance of a machine switching office gives one the impression of a large manual office apparatus room containing many

iron frames of selector equipment.

There are five major frames shown and with the exception of the senders and sender selectors, these frames look and function very much like the first "line finder frame". The second is known as the "district frame", and the third as the "office frame"; the fourth as the "incoming frame" and the fifth as the "final frame", on which a call to a subscriber is completed. The line finder, district and office frames are fairly comparable with the manual "A" board without a subscriber's multiple, while the incoming and final frames may be considered to function like the "B" board in a manual office.

APPARATUS ARRANGEMENT

All of the frames have an individual two roll friction drive, the top roll being used for the down drive, the lower roll for the up drive. See sketch #2. The only exception is on the final frame which has two up drive rolls, one a high speed and the other a low speed; the latter's function being explained under "Final Frames".

Each frame, with the exception of the "Line Finder" frame, is equipped with five multiple banks. A multiple bank has a capacity of 100 lines or trunks and each frame a capacity of 500 lines or trunks. Each circuit is also equipped with a commutator and a sequence switch as shown in sketch #3. ^{none} There are, of course, several different kinds of commutators and sequence switches depending on the circuit and frame they are associated with but in general they look alike.

NEW APPARATUS

The principal new apparatus is as follows:

- 1- Multiple Bank
- 2- Commutator
- 3- Sequence Switch
- 4- Rotary Switch
- 5- Friction Roll Drive
- 6- Clutch
- 7- Elevator, showing rack, brush, brush-rod and trip rod.
- 8- Dial.

TRAFFIC ARRANGEMENTS

Figure No.1 shows in general the way the apparatus is arranged in the circuit and the sequence followed in completing a call, remembering that the only new function to be accomplished by machine switching apparatus is to do the work of the operators by mechanical means.

In the manual exchange the subscriber removes the receiver from the switchhook and awaits the operator's response of "number please" before giving the number required. Before the operator gives this signal that she is ready to receive your number, she has a number of functions to perform. Similarly, when the receiver is removed from the switchhook in the machine switching exchange, there are a number of functions to be accomplished before the apparatus is in a receptive condition to receive the impulses from the subscriber's dial and to prevent the subscriber from dialing too soon, he is instructed to wait until he hears the dial tone before dialing.

This dial tone is comparable with the operator's "number please" indicating that the circuit is ready to function.

The Panel Machine Switching System to be installed in Seattle is known as a six digit system. For example - to dial NOOrth 1567, (NO 1567) requires six operations of the dial. NOOrth 0015 must be dialed as NO-0015 as there must be six digits dialed for all subscriber's numbers; in other words, zeros must be prefixed to numbers less than one thousand (1000) in order that six digits are registered. The following analogy should be carefully studied and firmly fixed in your mind:

PARALLEL OPERATIONS

MANUAL SYSTEM

Subscriber's Line:

When a receiver is removed from a hook at a manual subscribers station, a lamp signal appears before the operator. Her first act is to select an idle answering cord from the seventeen pairs of cords before her and connect it with the calling line.

MACHINE SWITCHING SYSTEM

Line Finder Circuit:

When the receiver is removed from the hook at a machine switching subscriber's station, a selector called a "Line Finder" automatically starts to hunt for the line initiating the call. When the brushes of the line finder come into contact with the terminals of the calling line, the line finder stops on the terminals. This action of the line finder locating the line has duplicated the first move

of the operator, namely, plugging in of the answering cord. Each line finder selector is connected to a district frame circuit called a district selector which is comparable with the calling cord, and a district sender selector.

District Sender Selector:

As soon as the line finder starts to find the line, a district sender selector starts to select an idle sender.

Subscriber Gives the Number:

The operator's next move is to open the listening key and ask the subscriber for the number. The operator then starts to complete the connection to the called subscriber.

Sender Gives Dial Tone:

As soon as the line finder finds the calling line and the district sender selector finds an idle sender, the sender connects the dial tone to the line indicating to the subscriber that the sender is ready for the subscriber to dial the called number.

Subscriber Dials the Number:

The operator of the dial at the subscriber's station stores the impulses representing the exchange and line number wanted in the "sender" referred to above.

Exchange Designation:

Where there will not be over 64 offices requiring letter codes,

in any one city, it will only be necessary for the subscriber to dial two letters to reach the office required. For example - in a manual directory we might have a telephone listed as Main 9786, but upon conversion to machine switching, "Main" would be expressed as MAIn 9786. In this case you would dial the number as MA 9786 which would be stored in the six register switches of a sender. The first register switch would stand in position six, the second register switch in position two, the third register switch would stand in position nine, the fourth register switch in position seven and so on for the six digits.

Sender:

While the sender may seem a complicated arrangement of apparatus, don't forget its simple function of mechanically absorbing the dial pulses corresponding to the answer to an operator's "number please". It responds to the dial in a very human way, setting its switches in correct sequence until the subscriber has dialed the complete number.

The number we are using here is West 3496. As it is only possible to store one digit in each register switch, it will be necessary in this instance to have six register switches in each sender, so that the full number may be stored before the selection of the called line is completed.

Bear in mind that the sender is the operator in a machine switching exchange. It receives the number wanted from the dial by recording or storing the different digits in its switches as they are dialed, preparatory to their subsequent release at the proper moment.

Order Wires:

The operator presses an order wire button which connects her with an operator in the West exchange, telling her that 3496 is wanted. The "B" operator in the distant office then assigns a trunk to which the first operator connects the calling cord, thus completing the connection to the desired exchange.

District Selector:

The sender, having received and stored necessary impulses from the dial, is ready to control the operation of the district selector which hunts an idle trunk going to the desired office.

Its first action in the district frame will be to trip the proper brush to engage a terminal in a group of trunks to the office wanted. As soon as this is accomplished, it causes the elevator to move upward to the group

being selected. When the tripped multiple brush has reached the first trunk in the group of trunks going to the particular office wanted, it will stop if this trunk is not busy, but should it be in use, the district selector circuit will keep the tripped multiple brush going upward until it finds a non-busy trunk.

When an idle trunk is found, the up drive magnet is released, the elevator stops and the brush stands on the first idle trunk to the office desired. Should all trunks be busy, a tone is returned to the calling station as a signal to hang up and call again.

A call enters a frame through the selector circuit and leaves the frame through its multiple bank terminals.

When office frames are used, the call moves from the district frame to the office frame, where it is mechanically handled in the same way. The office selector selects an idle trunk to the incoming frame in the office de-

sired. When trunks are busy a busy signal is returned to the calling station as a signal to hang up and call again.

The call now appears at the incoming frame which, for the call under discussion, is located in the distant West office.

"B" Operator:

As the "B" operator assigns a trunk after receiving the desired number over the call wire, she locates 3496 in the multiple in front of her.

Incoming Frames:

The sender now causes the selector on the incoming frame to move upward, the proper brush being tripped to select an idle trunk in a group of trunks connected to final selectors which have access to the multiple terminals to which the called party is connected. The thousands register determines which incoming brush is tripped, and the thousands and hundreds register together determine the group to be selected.

Final Frames:

The "hundreds" register in the sender now determines which final brush is to be tripped. The proper brush is tripped to make contact with the terminals of the bank of one hundred terminals in which the desired station circuit is

connected.

The "tens" register controls the up drive of the elevator until the first line of the group of ten lines in which the called station is included has been reached. The "units" register then assumes control, switches on the low speed up-drive referred to under "Apparatus Arrangements" and controls the selector until the brush rests on the desired number.

Testing the Manual Line:

The operator, having located the desired number in the multiple, tests the line for busy. If the line is busy, she inserts the trunk cord in a busy jack, which signals the originating operator that 3496 is busy, and she so informs the subscriber, if he has not already hung up upon hearing the busy signal.

Final Selector Tests for Busy:

The final selector now tests the line and if the terminals on the final banks are found busy, the selector returns a busy signal to the call originating station. This is a signal for the calling subscriber to replace the receiver on the hook, and all apparatus except the sender selector returns to normal. The sender selector brushes remain on the terminals connected to the sender just used and when the sender selector is next used it will select this sender, if it is not made busy in the meantime by another

sender selector.

Non-Busy Line:

Should the line not be busy, the "B" operator inserts the plug in the line called. The ringing apparatus contained in this circuit rings the subscribers bell and automatically disconnects itself when the called party removes his receiver from the hook and sets the supervisory signals to show the connection is completed.

Disconnect

The disconnect is controlled from the calling station. Hanging up the receiver gives the "A" operator a signal to take down the answering and calling cords. This in turn signals the "B" operator to disconnect her trunk.

Non-busy Line:

If the final selector's test of the line shows it is not busy, the ringing relays will then ring the bell at the called station. The sender is discharged when all the selections it is required to make are completed. When the called station answers, the selector sequence switches move into the talking position.

Disconnect

The disconnect is controlled from the calling station. When the receiver is placed on the hook at this station, the line circuit is opened and the supervisory relay on the district frame is released. This in turn causes the cut-off relay in the line circuit to release and a circuit is closed to restore the line finder to normal.

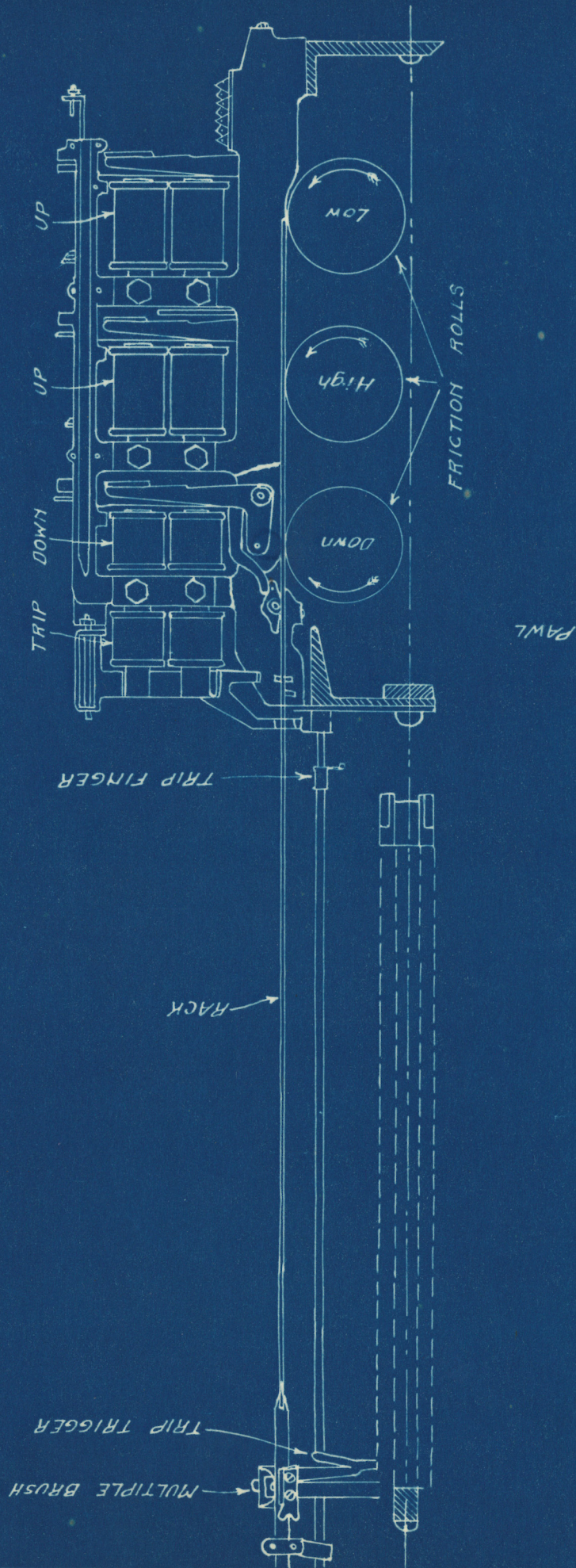
The district frame apparatus has meanwhile returned to normal and in turn

restores the apparatus on the other frames to normal. Thus, all component parts of this particular selection or call are at rest ready for the next mechanical "number please".

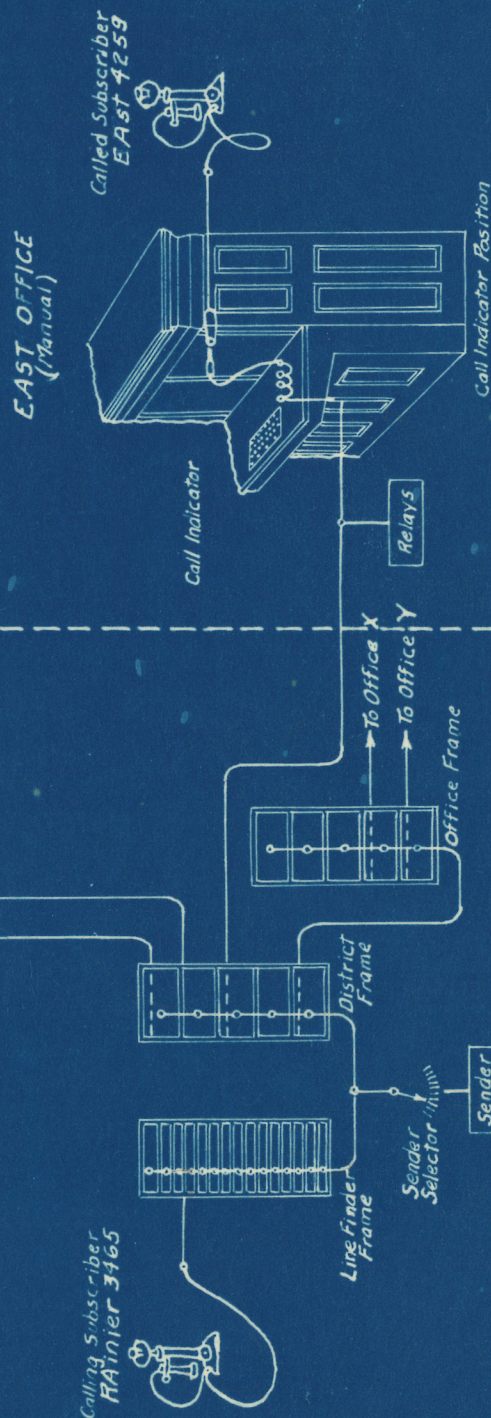
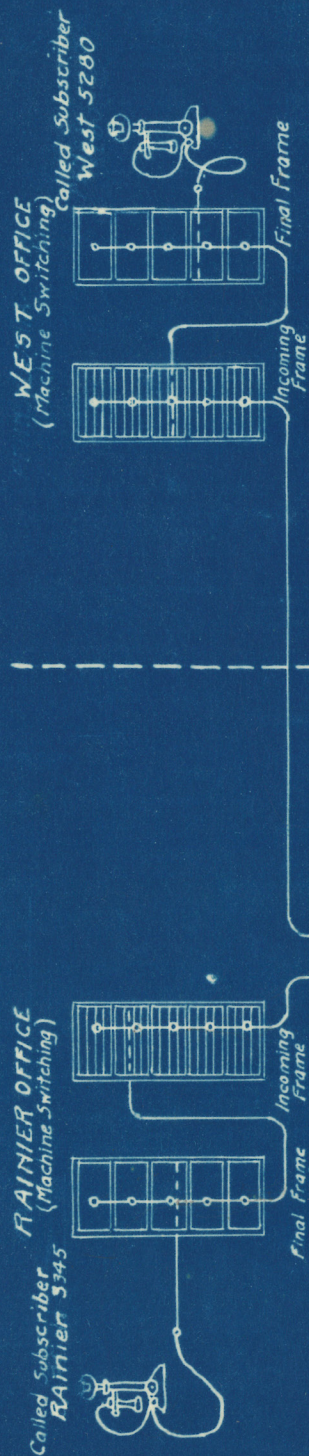
SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- What is meant by the term "Machine Switching System"?
- 2- Give the difference between the Machine Switching System and the Manual System?
- 3- Give a description of a Machine Switching Office?
- 4- What is the purpose of the several selector frames?
- 5- Name eight new pieces of apparatus used in a Panel Machine Switching System.
- 6- What is the purpose of the dial tone?
- 7- What is meant by the term "six digit system"?
- 8- Give in detail the parallel operation of the "Machine Switching System" and the "Manual System"?



MULTIPLE BRUSH-TRIP ROD
 FRICTION ROLLS & CLUTCH
 LESSON-#1 SKETCH-#2
 LESSON-#3 SKETCH-#2



CALL ROUTINGS

MECHANICAL TO MECHANICAL & MANUAL

LESSON #1

SKETCH #4

PLANT SCHOOL

SEATTLE WASHINGTON

PANEL MACHINE EQUIPMENT

LESSON NO. 2

SUBJECT

FRAMES.

LESSON NO. 2

DESCRIPTION OF FRAMES AND FUNCTIONS PERFORMED

LINE FINDER FRAMES

Each subscriber's line terminates on a multiple terminal that appears in a bank on Line Finder Frame (see sketch #1 Fig #1). The Line Finder frame has fifteen banks, and each bank has terminal for twenty subscriber's lines or a total of three hundred subscriber's lines, the multiple terminals extend through multiple bank and each Finder Frame is equipped with thirty selectors on each side frame which are known as Line Finders.

When the subscriber removes his receiver from the hook, a circuit is completed through the line relay which is associated with the finder circuit. The operation of the line relay controls the starting circuit of the line finder which causes an idle line finder to move upward, hunting for the terminals of this line, and connects battery to one of the terminals of the line known as the "Hunting Terminal". When the contacts of the multiple brush reach this terminal the driving circuit of the line finder is opened, and the line finder is stopped with its brushes in contact with the terminals of the line. The trip circuit is for tripping a particular multiple brush as it starts upward. Each line finder selector is permanently connected with a selector at the district frame, and thus the circuit is carried from the line finder frame to the district frame.

A standard Line Finder frame is equipped with multiple slipped in the center of each bank and the two halves reversed as shown in sketch #2, fig.#1. Sketch #2, figure #2 shows an arrangement of Line Finder frame with line capacity of nine hundred terminals per each two frames, with each line multiplied before forty line finders. Multiple banks are split on a vertical line so located that forty line finders are on one side of split and twenty on the other.

Sketch #2, figure #3 shows an arrangement of Line Finder frame with Multiple arranged for line capacity of six hundred terminals per frame each line multiplied before twenty-eight selectors, multiple banks are split on a vertical line at the center.

DISTRICT SELECTORS

The district selector is of the trunk hunting type. Outgoing, inter-office and local trunks terminate on the multiple banks of the district frame and trunks from the Line Finder selectors terminate on the selector mechanism. The local outgoing trunks may be trunks to the incoming selectors in the same office or in another office in the same building, or they may be trunks to office frame selectors.

The district selector frame has five banks of multiple terminals. The one hundred sets of terminals on each multiple bank are arbitrarily divided into ten groups representing trunk groups and are known as multiple layers. Eight of the layers contain eleven sets of terminals each, and two layers contain six sets each. (See sketch #1, Fig.#2). The top set of terminals in each layer,

called overflow terminals, are used to give a busy signal when all trunks terminating in the layer are busy. Deducting the ten sets of overflow terminals, the capacity of each multiple bank is ninety trunks. Groups of more than ten and ninety or less trunks can be obtained by making the overflow terminals between layers test busy so that the trunk selector is carried from one layer to the next above it.

Accordingly, the multiple on a district frame may be arranged in any combination between the limits of forty groups of ten and ten groups of five trunks down to five groups of ninety trunks.

The functions of a district selector are as follows:-

- 1- To connect the line finder to an idle sender for receiving and registering the dial impulse.

- 2- To make connection between the subscriber's line and an idle outgoing inter-office trunk to the called office at the multiple bank of the district selector.

- 3- To disconnect the sender from the trunk when the selector of called station is completed.

- 4- To supply battery to the calling station for talking.

- 5- To operate the message register if the calling line is a measured service line when the called station answers.

- 6- To connect a sender to the line for collecting or refunding the coin in coin box lines at the completion of the call, if the calling line is equipped for coin collect service.

- 7- To send a busy tone to the calling subscriber, if required.

- 8- To disconnect the line finder and return the district selector to normal when the calling subscriber hangs up the receiver.

OFFICE SELECTOR

The office selector is of the trunk hunting type. Outgoing interoffice trunks terminate on the office frame multiple banks and local trunks from the district frame terminate on the selecting mechanism. The one hundred sets of terminals of each multiple bank are arbitrarily divided into ten layers as on the district frame and the same combination of trunk groups can be obtained.

This frame may be used when the number of outgoing trunks required exceed the capacity of the district frame.

The function of the office selector is to make connection between a trunk from the district selector frame multiple bank and an outgoing trunk terminating on the office frame multiple. Office frames are not used in Seattle installation.

INCOMING SELECTORS

The incoming selectors are trunk hunting selectors. Trunks to the selecting mechanism on the final frames terminate on the multiple banks of the incoming selector frames and the incoming trunks, local or interoffice, terminate on the selecting mechanism.

The capacity of the final selector frame multiple is five hundred lines and to care for a fully equipped unit of ten thousand stations, twenty sets of final frame multiple are necessary. It is, of course, essential that any trunk incoming to the office shall have access to each one of these sets of final multiple. Therefore, it is necessary to have twenty groups of trunks terminate on each incoming frame multiple.

Dividing the capacity of the incoming trunk multiple (five hundred sets of terminals) into twenty equal groups, gives twenty

groups or layers of twenty-five terminals each. The one hundred terminals of each multiple bank is thus divided into four multiple layers.

The top set of terminals in each layer is reserved for overflow as in the district and office selectors so that each layer has a capacity for twenty-four working trunks.

Since one layer of incoming selector frame multiple must be reserved for trunks to each set of final frame multiple, it is impossible to build up groups of trunks larger than one layer on any incoming frame by making the overflow terminate between layers test busy. (See sketch #1, Fig#3). Therefore, split groups of trunks are used to obtain the number of trunks required to one set of final multiple. For example, if sixty trunks are required to the subscriber's lines terminating on one set of final multiple, twenty-four of these trunks will appear in the multiple of one group of incoming frames, twenty-four in the multiple of a second group, and twelve in the multiple of a third group.

The functions of the incoming trunk selector are as follows:

- 1- To make connection between an incoming trunk from a district or office frame to a trunk to the particular final frame where the called station's terminal is located.
- 2- To ring the called station when the line has been selected at the final frame.
- 3- To supply talking battery to the called station.

FINAL SELECTORS

The final selector is of the particular line selecting type. The subscriber line multiple terminates on the multiple banks

of the final frames and trunks from the incoming selector frames terminate on the selecting mechanism.

Each of the five banks on a final frame provides multiple capacity for one hundred subscriber's lines. In selecting a particular subscriber's line, the group of ten lines in which it is located is selected in the same manner as a particular group of trunks is selected on a district frame. (See sketch #1, Fig. #4).

The selecting brushes are driven up for this "tens" selection by the high speed friction roll. In selecting the desired line in the group of "ten", the selecting brushes are driven up by the low speed friction roll.

A final frame may be arranged for 500 or 1000 terminals depending on whether the banks are not or are split.

Since the capacity of a final frame is sixty selecting mechanisms there will be only sixty trunks from incoming selectors having access to the five hundred subscriber's lines unless these lines are multiplied to additional selector frames. Where more than sixty trunks are required to care for the incoming traffic to the five hundred lines terminating on a final frame, an additional frame or frames are provided and the subscriber's multiple extended to the multiple bank. For example, if the traffic to a particular group of five hundred subscriber's lines require one hundred twenty trunks from the incoming selectors, two final frames would be provided with their multiple banks wired in parallel. Frames used for providing the additional selectors are furnished with a capacity for sixty selectors, but if the estimated number of selectors required on the additional frames to care for the calls to five hundred

red stations is less than thirty, the multiple banks may be cut on a vertical line in the center and one half only used in connection with the first frame.

This permits the other half of the multiple bank to be used as an additional multiple for another frame.

In such cases the multiple cables from one frame are brought in at one side of the additional selector frame and the cables from another frame at the other end. Where the number of additional selectors are required is between thirty-one and forty, inclusive, a frame may be used with the multiple banks cut on a vertical line between terminals forty and forty-one, (see sketch #3), thus dividing the frame into two multiples, one reached by forty selectors and the other by twenty selectors. It is thought that there will seldom, if ever, be cases where the bank for twenty selectors can be used economically and in order that it may be multiplied to another bank of twenty, thus giving a capacity of forty, final frames split 30-30 are provided when 30 or less final selectors are required.

The functions of the final selector are as follows:-

- 1- To make connection between the trunk from the incoming selector frame and the line of the called station.

- 2- To test the called line for busy and return a busy tone to the calling station if the called line is busy.

- 3- To test all lines in a group to a private branch exchange before returning a busy signal to the calling subscriber.

- 4- To operate the cut-off relay of the line circuit when an idle line is seized.

- 5- To make the multiple terminals of the selected line test busy so that no other final selector will seize the line.

SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- What is the capacity of the Line Finder Frame?
- 2- How many banks on the Line Finder Frame?
- 3- How many lines in each bank?
- 4- How many selectors on each side of Line Finder Frame?
- 5- How many multiple terminals required for each line?

Name same.

- 6- Describe how the Line Finder selector locates the multiple terminal of the line originating the call.
- 7- How are the circuits extended from the Line Finder to the district frame?
- 8- On a standard Line Finder Frame, how is the multiple on each bank arranged?
- 9- Describe the three different methods of arranging the multiple on Line Finder Frames to increase the capacity of the frames.

SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- Of what type is an incoming selector?
- 2- What class of trunks terminate upon this frame?
- 3- How is the capacity of the incoming frame multiple divided?
- 4- When the trunk requirements for the subscriber lines terminating on one set of final multiple exceed 24, what provision is made to furnish the additional trunks?
- 5- What are the functions of an incoming selector frame?
- 6- Of what type is the final selector frame?
- 7- What is the capacity of this frame?
- 8- How many frames are required for 500 subscriber lines?
- 9- How many selectors on a final frame?
- 10- What provision is made where more than 60 trunks are required for any one group of 500 subscriber's lines?
- 11- What is meant by "splitting frames"? What is gained by splitting final frames?
- 12- What are the functions of a final selector?

SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lesson.

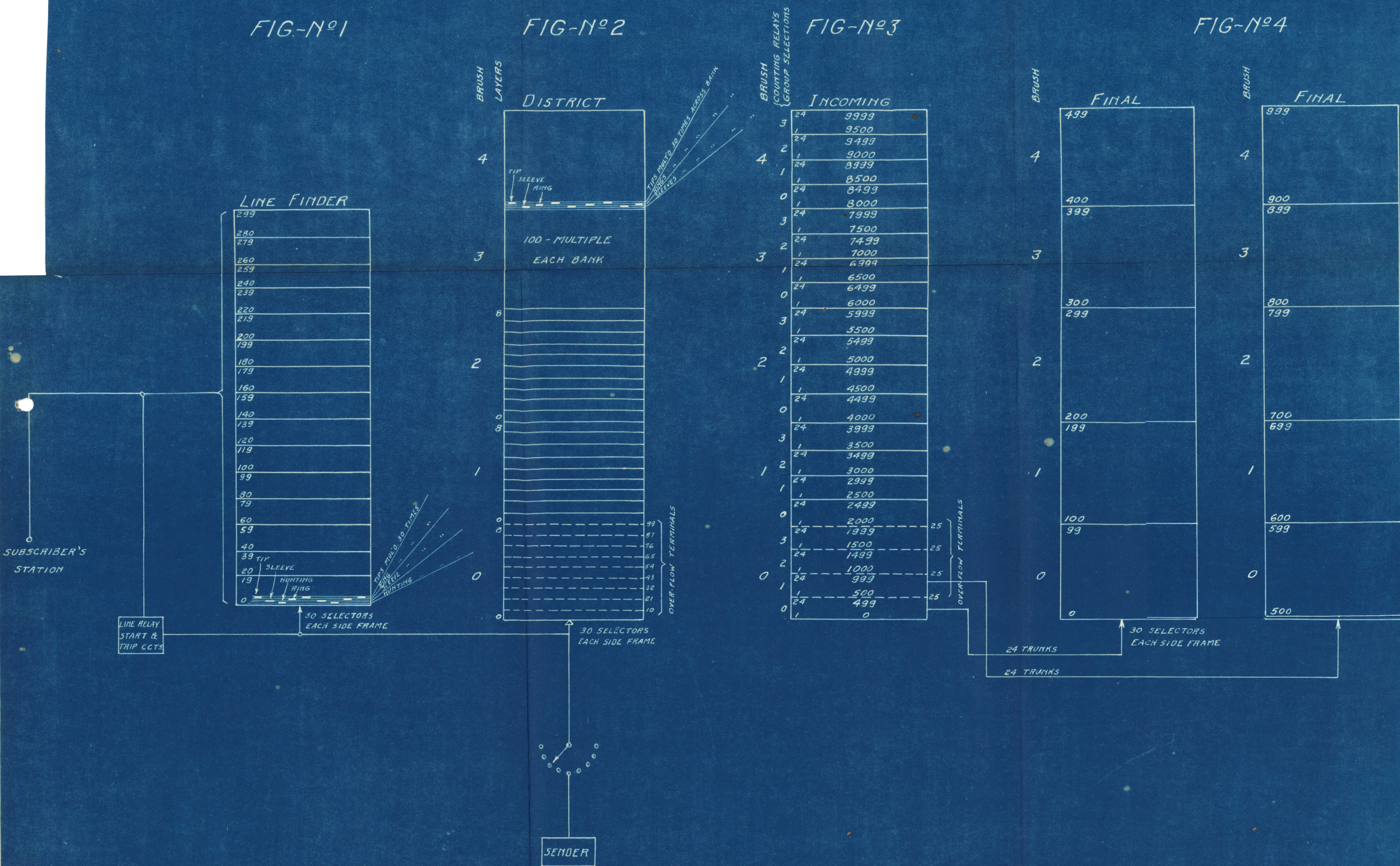
- 1- Of what type is the district selector?
- 2- What trunks terminate on this frame?
- 3- How many sets of terminals in each multiple bank?
- 4- How is a multiple bank divided?
- 5- What use is made of the top set of terminals?
- 6- How may trunk groups be increased?
- 7- How may the multiple be arranged?
- 8- When is an office frame necessary?
- 9- How are the 100 sets of terminals divided?
- 10-What are the functions of a district selector?

FIG-Nº1

FIG-Nº2

FIG-Nº3

FIG-Nº4

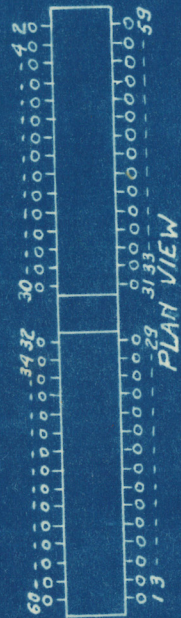
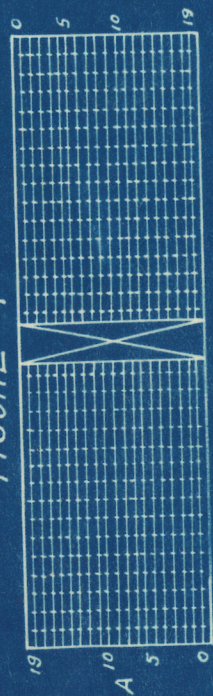


FRAME EQUIPMENT

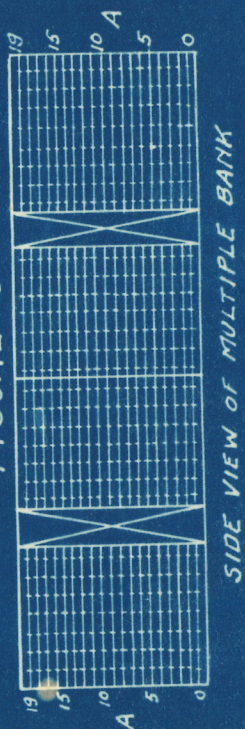
LESSON-#2

SKETCH-#1

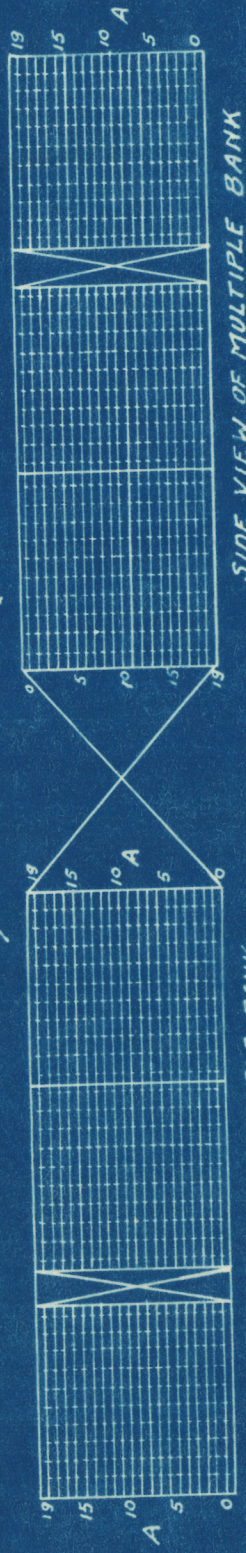
FIGURE~1



FIGURE~3



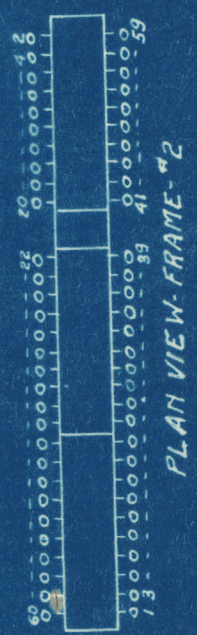
FIGURE~2



FRAME~#1



FRAME~#2



ARRANGEMENTS OF LINE FINDER MULTIPLE BANKS

LESSON-#2

SKETCH-#2

FINAL FRAME

100 MULTIPLE

100 MULTIPLE

100 MULTIPLE

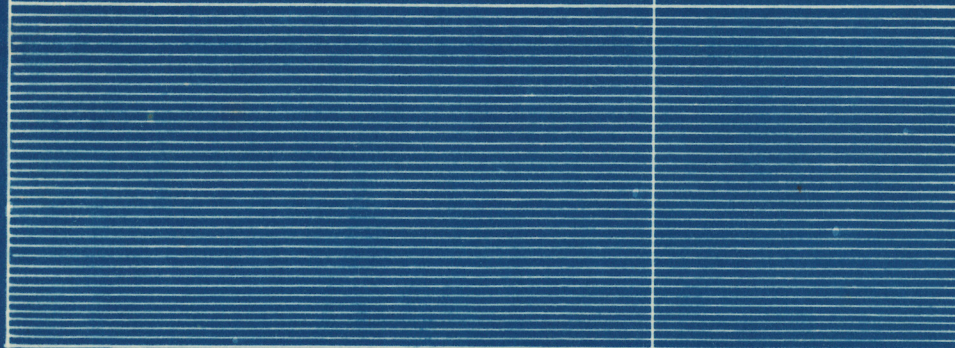
100 MULTIPLE

SPLITTING MULTIPLE BANKS
ON
FINAL FRAME

LESSON #2

SKETCH #3

ALT



2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60

REAR SELECTORS



1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59

FRONT SELECTORS

LESSON NO. 3

FRAME EQUIPMENT.

MULTIPLE BRUSHES ON THE DISTRICT OFFICE- INCOMING AND FINAL FRAMES.

The multiple brushes are sets of springs similar to key springs which wipe over the terminals of the multiple banks and make electrical connections to the particular set of terminal selected. (See sketch #1 and #2 and sample.) One multiple brush is provided on each brush at each of the multiple banks on a frame. Each brush consists of tip ring and sleeve springs for making contact with the corresponding terminals in the multiple bank and a device similar to a key plunger for throwing these springs in or out of their contact position. The brushes on one brush support rod are connected in multiple. Accordingly, it is necessary to move the brush support rod over the distance occupied by one multiple bank only in order to bring all of the five hundred sets of multiple bank terminals on a frame within reach of some one of the brushes.

BRUSH SUPPORT.

Each set of five selecting brushes is mounted on a hollow rod mounted vertically before the multiple banks as shown on sketch (See sketch #1).

These rods are free to move up and down over a distance equal to the height of one multiple bank.

Thirty brush support rods are located on each side of the multiple bank.

The wiring from the commutator brushes to the multiple brushes and between multiple brushes on one rod is carried inside the rod.
RACK.

Attached to the bottom of the brush support rod is a flat strip of metal known as the rack (See sketch #1, and sample) which extends downward immediately in front of the friction rolls between the rolls and the armatures of the clutch magnets. When a clutch magnet operates, a small roller on its armatures presses this strip of metal against the friction roll which drives it up or down carrying the brush support rod with it. The metal strip has a series of horizontal slots cut in it corresponding to the centers of the sets of terminals in a multiple bank.

A pawl on the clutch engages with these slots during all the upward movements of the brush support and prevents the support from falling back when it is driven to the desired height. (See sketch #2).

CLUTCH.

The clutch is the part of the selector mechanism used in panel type machine switching offices which applies power to elevate and lower the multiple brush support rod and supports it when in the elevated position. (See sketch #2).

Clutches may successively elevate the brush rod at high and low speed as for a final selector or elevate at high speed only and so these two types are designated as "two speed" and "single speed" respectively. The trip magnet and mechanism for rotating the trip rod are mounted on the framework of clutches which are arranged for brush tripping. The clutch proper performs its functions in conjunction with the friction rolls of the power drive unit and therefore mounted

with a number of others directly in front of these rolls. Each clutch supports on its frame some or all of the following parts:

- 1- The up drive magnet and roller (high speed).
- 2- The up drive magnet and roller (low speed on final selectors only).
- 3- The Pawl. (See sketch #2)
- 4- The trip magnet and trip armature.
- 5- The down magnet, roller and pawl trip lever.

The operation of the clutch is as follows:

The High speed up drive clutch is first energized and its roller presses the rack against the high speed up drive friction roll, driving the rack and brush rod upward at high speed (about sixty terminals per second). At the height where brush selection is to take place, the up drive magnet is deenergized, removing the up drive power. The pawl which is normally in engagement with the rack enters a slot in the rack at this point and holds the rack and brush in place. The trip magnet then operates to rotate the trip rod as described in detail under "Trip Rod". The high speed clutch magnet is then again energized to trip the brush and carry it to the desired group of terminals and then to choose any idle trunk in the proper group. In the case of a final selection this last operation does not take place, but the slow speed up drive power is applied by energizing the slow speed up drive magnet to choose the proper terminal.

In restoring the selector to normal, the down drive magnet is energized and attracts its armature which first disengages the pawl from the rack due to the movement of the pawl trip lever and then lowers the rod by friction against the down drive roll. When the

down drive magnet is energized this panel is released.

TRIP ROD AND TRIP FINGERS.

When the brush support is in its normal position, the contact springs of all the multiple brushes are held by a plunger similar to a key plunger so that they do not make contact with the terminals on the multiple bank. The selection of the particular brush to be used consists of tripping this plunger so that the contact springs on the brush selected make contact with the multiple bank terminal. (See sketch #1 and #2).

A small rod, known as the trip rod, is mounted vertically behind the brush support between it and the multiple bank. This rod is mounted rigidly as regards up and down movement, but is arranged so that it can be rotated. Each rod is equipped with a trip finger at each multiple brush and the trip fingers are set at different heights relative to their associated brushes.

In selecting a particular brush, the brush support rod moves upward until the tripping device on the brush desired is opposite its associated trip fingers. In this position the trip fingers corresponding to the other brushes on the rod are not opposite the tripping device. The trip magnet operates and causes the trip rod to revolve, which brings the trip finger to the tripping position and at the next upward movement of brush support rod, the selected multiple brush is tripped.

COMMUTATOR. (See Sample).

The commutator is the part of the selector used in making selections and in maintaining the circuits to and from the multiple brushes. It consists of a flat bar of insulating material in both sides of which are imbedded a number of metal contact strips.

The feeder side of the commutator contains a number of wide slotted contact strips and in some cases one or more of the narrow feeder strips.

The commutator brushes are mounted at the top of the multiple brush rod and traverse both sides of the commutator. The wires from the multiple brushes which are all wired in parallel pass up through the hollow brush rod and thence to the commutator brushes which make contact with the feeder strips. The upper ends of these strips end in soldering terminals to which external circuits connect. Likewise, the external circuit used in making selections may connect to other feeder strips and is extended through the feeder brushes and wiring to the interrupter contact brushes, to the slotted interrupter strips and to the external circuit.

The top and bottom of each commutator are inserted in slots in the mounting plates located above the top multiple banks. The bottom is held in place by a spring or clip and the top by a small bar or yoke fastened with two screws.

FRICTION ROLLS.

The friction roll drive is the means of transmitting power from the drive motor to the friction rolls. It consists of a frame supporting the motor driven up and down drive friction rolls, and usually an arrangement for driving the sequence switch drive shafts on a frame.

All drives have two sets of rolls, one for each side of a frame. There are usually two rolls per side, the high speed up drive and the down drive, except on final frames which have an additional low speed up drive on each side. These two types are therefore designated as single speed and two speed respectively. Each side may

be driven by an individual motor or connecting shafts may be used so that one motor drives one side of two adjacent drives.

These rolls are steel shafts with bearing surfaces at each end and covered throughout the major portion of their length with a smooth cylindrical layer of cork securely attached to the steel surfaces underneath.

THE INTERRUPTER. (See Photographs)

The power driven interrupter is a device for furnishing interrupted current to some of the circuits in panel type machine switching offices.

It consists of spring assemblies in which contacts are made and broken by a reciprocating bar, actuated by a roller mounted on it, which rides on the periphery of a revolving cane.

These interrupters are mounted at the top of the equipment frames so as to be driven by the vertical sequence switch drive shaft. Each mounting has a capacity of thirty sets of springs, but may be equipped with any number from one to thirty the spring assemblies may be arranged to make or break one or more circuits.

TYPES OF FRAMES.

Selector frames are divided into two types, the district, incoming and office frames are of the trunk hunting type while the final and line finder frames are of the particular line hunting type.

SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- What is the construction of the multiple brush - its purpose?
- 2- How many brushes on one support rod?
- 3- Describe a brush support rod.
- 4- How many brush support rods are mounted on a frame?
- 5- What disposition is made of the wiring?
- 6- To what use is the rack put?
- 7- What is the purpose of the slots?
- 8- What is meant by a clutch?
- 9- Describe a trip rod and its use.
- 10- Describe a commutator. What is the purpose of the brushes?

SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- How many friction rolls are provided on each frame?
- 2- What is their construction?
- 3- Selector Frames are divided into two types- What are they?
- 4- How do they differ in operation?
- 5- What are the purposes of the different speed of rolls and their direction?
- 6- How are these rolls driven?
- 7- What is the arrangement of the motors?
- 8- What is the advantage of this arrangement?
- 9- How is an odd number of frames cared for?
- 10- Why are interrupters required?
- 11- How driven?
- 12- How mounted?
- 13- What is their capacity?
- 14- What are they designed to do?
- 15- Describe an interrupter?

MULTIPLE BRUSHES ON LINE FINDER FRAME.

The Line Finder brushes are of the same general type as just described for district, office, incoming and final frames except that the two center springs are offset in such a way that one makes contact with the sleeve terminal of the multiple bank and the other with the hunting terminal. The tip and the ring springs are the outside springs, the brushes wipe the terminals of the bank of multiple corresponding to the brush that is tripped both on its upward and downward travel. (See sample multiple brush.)

A Line Finder brush is provided for each multiple bank, all fifteen brushes being connected in multiple, the wiring extending through the hollow brush support tube, which the brushes are mounted on, and terminating on the commutator brushes at the top of Line Finder frame, and as there is a brush for each multiple bank it is only necessary to move the brush support over a distance corresponding to the height of one multiple bank in order to bring all of the terminals of the three hundred lines terminating on a frame within reach of the fifteen brushes.

BRUSH SUPPORT.

The fifteen multiple brushes on the line finder are attached to a hollow metal rod mounted vertically before the multiple banks. To the bottom of this rod is fastened a rack and at the top is fastened a set of commutator brushes. The rod, the multiple brushes, the commutator brushes and the rack are known collectively as the brush support. One half of the brush supports are mounted on each side of the multiple bank. The brush supports are free to move up and down over a distance equal to the height of one multiple

bank.

The brush support moves up and down when the rack is pressed against the revolving up or down friction rolls by the clutch mechanism and is held in an operated position by a pawl which engages the slots in the rack.

CLUTCH MECHANISM.

The Clutch consists of only one up drive and one down drive magnet. Trip rods individual to each selecting mechanism are required and therefore the trip magnet is omitted from the clutch assembly.

TRIPPING MECHANISM.

Horizontal trip rods are provided for each multiple bank located on both sides of bank somewhat below the bottom terminal strip. Each trip rod carries a trip finger for each line finder in the group on the same side of multiple bank. That is, if the frame is arranged for one group of sixty line finders, one trip rod carrying thirty trip fingers is provided on each side, of each multiple bank. The trip rods extend across the frame in such a way that when revolved by their associated trip magnets all of the trip fingers are placed in position to trip the corresponding brush of any line finder that starts to move upward by the tripping trigger of the brush becoming engaged with one of the trip fingers on the trip rod.

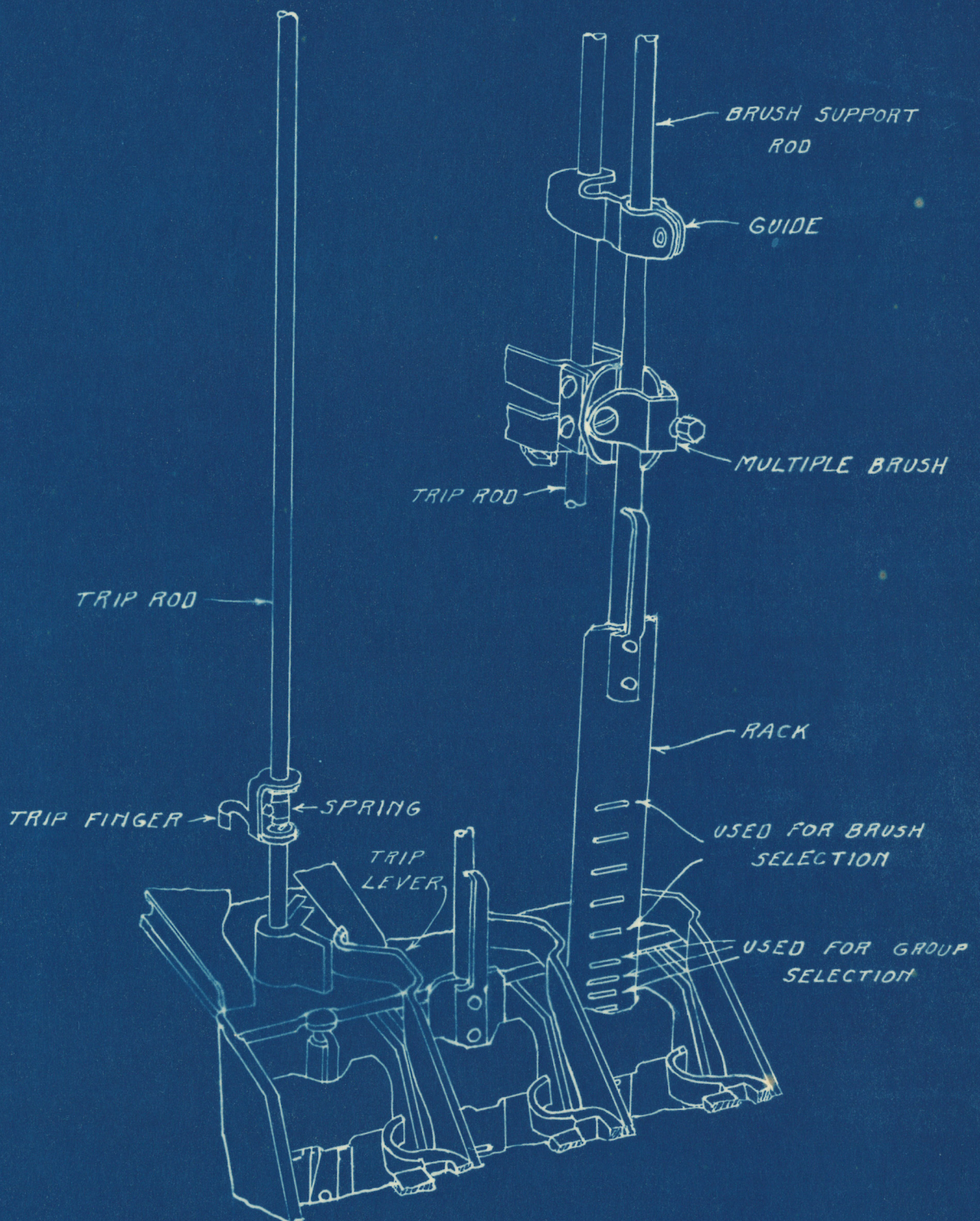
COMMUTATOR.

The line finder commutator is similar in design to the commutators used on selector frames. (See sketch #3) showing arrangements of segments of a Line Finder commutator. Segment "G" is connected to ground, and the brushes that make contact with G segment are strapped to the brushes that make contact with segments C-K, X-M and N and segments marked T-R-S and H provide means for making connections to the multiple brush springs. (See sketch #3).

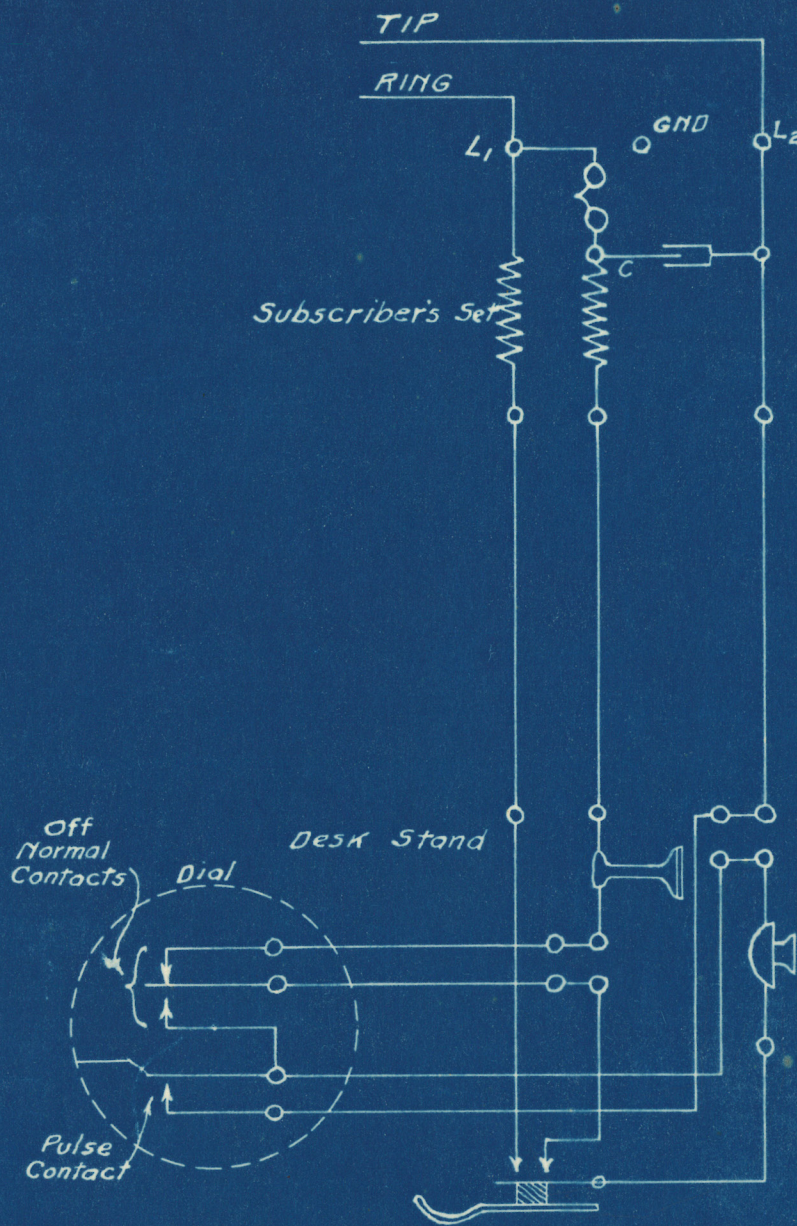
SELF TEST QUESTIONS.

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- Describe the construction of Line Finder Brush.
- 2- How many brushes on one brush support rod?
- 3- Describe how the brushes are wired.
- 4- What constitutes a brush support?
- 5- Describe how the brush supports are elevated or lowered.
- 6- Describe the Clutch.
- 7- Describe the tripping mechanism on Line Finder frame.
- 8- Describe Line Finder commutator and wiring arrangements.



TRIP ROD & GUIDE



Note: (1) When pulse contact is made, receiver circuit is opened up, while transmitter circuit is shorted out.

SUB-STATION CIRCUIT

LESSON N^o 3

PLANT SCHOOL

SEATTLE WASHINGTON.

PANEL MACHINE EQUIPMENT.

LESSON NO. 4

SUBJECT

ROTARY SWITCHES.

LESSON NO.4

ROTARY SWITCHES

The No. 200 type selector is a step by step rotary switch used in panel type machine switching offices as a sender selector, register, register control switch and for a number of other similar purposes. Selectors performing different functions differ only in the number of bridging and non-bridging brushes on their motors and in the terminal arrangement of their associated banks.

The selector consists of a self interrupting motor magnet arranged to rotate a set of brushes by means of a pawl and ratchet over a semi-circular bank of terminals associated with the selector. The selector is mounted with the axis of the revolving member horizontal and concentric with the semi-circular bank. It is arranged so that when the ratchet is advanced one step the brushes move from one set of terminals to the next. Each time the magnet operates the pawl is advanced one step and when the magnet armature faces back the ratchet is advanced one step. When the magnet attracts its armature it also opens a pair of contact springs, and so the selector may be wired to be self interrupting.

The bank associated with a selector has a capacity of six arcs of twenty-three terminals each suitable insulated and clamped between two semi-circular plates, one of which has an elongated portion at each end which is bent through 90 degrees to form brackets for mounting. These terminals extend through the mounting and pro-

vide wiping contacts for the brushes on the inner surface of the mounting and soldering lugs for the bank wiring on the outer surface. The first set of terminals in the multiple bank is used for terminating the circuit to the brushes. Each such terminal consists of two flat springs which extend to the rotor shaft where they spread out from each other, so that each spring rests on the slip ring portion of the corresponding brush spring, thus establishing the circuit to the brushes.

The contact brush for each one of terminals consists of two flat metal strips so formed that each spring rests on the opposite sides of the same terminal when in the contact position. At the mounting shaft these brush springs are so formed as to provide the slip rings used for establishing the circuit to the brushes.

On the brush shaft there is a ratchet wheel with teeth cuttings corresponding to the spacing of the multiple bank terminals. The brushes suitably insulated in pairs from each other and from the shaft, are clamped between the ratchet on one end of the rotor shaft and a clamping nut at the other end. An indicating wheel numbered and spaced to correspond to the spacing of the bank terminals is clamped between the brushes and the clamping nut.

The rotor is mounted on the selector frame by suitable bearings and can readily be removed from it as a unit.

An indicator pointer is mounted adjacent to the indicating wheel to designate the position of the brushes on the terminal.

THE SEQUENCE SWITCH.

A sequence switch is a mechanism for connecting and disconnecting circuits as required at different stages of the operation

of a machine switching power driven system. It consists of a frame supporting a number of brushes, a clutch magnet at one end and a horizontal shaft which is power driven by a disc flexibly mounted on it. Rigidly secured to the switch shaft at regular intervals are a number of discs with insulating and conducting sectors on which the tips of the brushes rest. Terminals on the opposite ends of these brushes are wired to the circuit controlled by the switch. The switch is mounted adjacent to a constantly revolving verticle shaft to which is rigidly attached a driving disc with a small clearance between the disc and the one on the sequence switch shaft. When the clutch magnet is energized the face of the flexibly mounted disc is drawn against the rim of the driving disc so that the friction between them rotates the switch shaft and the disc rigidly mounted on it. The rotation of the insulating and conducting sectors of these discs between the brushes bearing on their opposite sides produce the required circuit changes.

The switch has a capacity from eighteen to twenty positions each of which may give different circuit combinations, and it can be designed to stop in any of them.

An index wheel and pointer at the right shows what position the switch is standing in. The disc having insulating and conducting sectors are called cams, and are designated from left to right by letters A.B.C., etc. The cam brush springs are designated by their position on the cam as left inner, left upper, right inner, and right upper. Those on the side toward the clutch or "R" magnet being the left and the one near the shaft known as the inner. The switches are made with a maximum capacity of either twenty or twenty-four cams.

The "A" Cam is a stamped circular metal disc with a corrugated rim and a disc of insulation riveted to its flat central por-

tion into which small rectangular notches are cut at the various positions in which the switch is designated to stop.

The remaining cams are each made up of a circular disc of insulation between two metal plates, the plates being riveted together and so electrically connected. All cams have a square hole at the center of the insulating disc, nicked on one side to assist the assembly for mounting on the shaft - the metal discs, however, are cut away at the center to always clear the shaft and often the metal collar between adjacent cams, and so the cutting about the center is utilized to insulate adjacent cams or to connect them with the aid of the metal collar. The metal collars which do not connect adjacent cams electrically are marked with a grooved ring around the outer surface: those connecting adjacent cams are not so marked. The metal plates are also so shaped or cut about the circumference that the brushes may rest on them or on the insulation, the associated circuits being closed or opened accordingly in the various switch position.

Since the switch has eighteen positions each position has twenty degrees of the cam. When a switch is centered on a position, the springs are located approximately so that ten degrees or one-half of the position is in front and ten degrees in the rear of the center of the springs. When "A" cam is cut in a position ten degrees of the metal, approximately in the center of this position, is cut away; that is, when the "A" cam is cut in a position and the switch is centered on this position the "A" spring will rest on the insulation.

When any of the cams B to G inclusive are cut to close contact with a brush in a regular single position, the first five and

and the last five degrees of the cam in this position are cut out, that is, a regular single cutting is a metal segment covering ten degrees of the cam in the center of the position and with the switch centered on this position the contact spring will rest approximately on the center of this metal segment.

When any cam from "B" to "G" is cut to close in successive positions, then no part of the metal is cut away from between the positions, that is, on a cam cut to close in positions one to three, the metal segment will start in position one in the regular way and will be continuous from positions one to three and end in position three in the regular way.

Now it will be seen that with one cam having a regular cutting in one position, and another cam having a regular cutting in the succeeding position when the switch is rotated the former cam will break contact with its spring before the cam and springs of the latter make contact. When circuit conditions require that one cam shall not break contact when moving out of a position until after another cam which is cut in the succeeding position, has made contact, then $1/4$, $1/2$ or $3/4$ cuttings are made. They are also used for other purposes. Figure 1 is a sketch of a cam showing all the angles into which both sides may be divided for the purpose of denoting the various cam cuttings possible. The position numbers are marked on the cam surfaces and a full heavy radial line drawn on which the brush tips rest when centered on these various positions.

These lines are twenty degrees apart.

These angles are divided in halves by the light radial lines and are designated by the number one-half. These half angles are

further subdivided by dotted radial lines denoting the $1/4$ positions so that in passing from the center of one position to the adjacent position in the direction of the Cam's normal rotation the $1/4$, the $1/2$ and $3/4$ lines of the twenty degrees angle between the adjacent position centers are clearly marked and designated. On circuit diagrams a notation is placed adjacent to each cam spring to denote the circuit changes of each spring during a revolution. A dash between two position numbers indicates circuit closure at the first position, an opening in the intervening positions and closure at the last numbered position.

A series of position numbers separated by dashes indicate a series of closures at these positions only: e.g., 1-5 means closed in position 1 and again in position 5. A fractional designation means that closure takes place in the position indicated by the number in the numerator and remains closed until the position indicated by the number in the denominator is passed, e.g., $1/5$ (read one to five) means a closure in position one which continues until five is passed. Furthermore it must be remembered that all circuit closures take place when five degrees or a quarter position is passed beyond the position numerically indicated as the point of circuits opening, e.g., a closure in position two would, referring to figure four, begin at position $1-3/4$ and end at $2-1/4$. Likewise cutting $2/5$ means closure begins at $1-3/4$ and ends at $5-1/4$. Fractional cuttings are made and indicated in the same manner as explained for the non-fractional cuttings above: e.g., $9-1/4 - 10-3/4$ would denote a cutting beginning at the center line of position nine and ending at the center line of position eleven, the cutting extending an additional five degrees beyond the position indicated by the numbers designating it. The accompany-

ing sketch of the circuit convention for the cuttings on the two sides of the cam is shown.

The brushes for Cams from "B" to "G" are mounted in groups of eight called brush assemblies, the brushes and alternate layers of insulation being clamped by screws between two metal stampings, one providing a base for mounting, the other a small designation plate on which the cam letters are painted. The brush springs are extended in the rear to provide suitable soldering connections. The "A" cam spring assembly has a stiff spring with a roller on its end which bears on the left side of the corrugated rim and acts as a centering device, and two springs which bear on the central position of the cam on the right side. The inner spring makes continuous contact of the "A" cam, the outer one rests normally on insulation making contact only between positions and at positions in which the switch is not designated to stop. This is to prevent the opening of the R magnet circuit at one of the other cams shortly after the switch moves out of position and the consequent stopping of the switch between positions, since as soon as the switch moves out of position, a circuit to the "R" magnet is closed through the "A" cam and its outer spring and is only opened as the switch arrives at its next stepping position.

SUBSTATION EQUIPMENT.

The types of substation equipment to be used in connection with panel Type Equipment offices are substantially the same as the present standards for manual operation with the exception of certain wiring changes and the addition of a dial.

The dial is used by the subscriber to transmit the number of the party with which he desires connection to the central office and cause it to be registered in the mechanism there.

The dial is mounted on the subscriber's telephone set in a convenient location and consists mainly of a set of switches operated by the subscriber in accordance with the movements of the number dial to perform the function necessary to set up the desired connection.

DIAL.

The moving portion of the dial which is revolving actuates the switches, consists of a finger dial, a number plate, a governor driving gear and an impulse wheel mounted on the main shaft. The dial is rotated in a clock-wise direction by the subscriber and during its return to normal the impulse switch contracts are opened and closed by the impulse wheel. When the dial is released after dialing a digit, it is driven back to the normal position by the motor spring, the speed of its return and consequently the rate of interruption of the circuit being regulated by a governor mounted on the back of the dial.

The rate of interruptions normally is between 8 and 11 per second, and due to the adjustment of the "I" relay, it is almost impossible to force the dial fast enough to conflict with the functioning of the apparatus. (See sketch #2).

The finger dial has ten finger holes through which the numbers on the number plate are visible. The numbers appear on the number plate in counter-clockwise order, "0" appearing under the tenth hole in the finger dial. This point is also marked "operator" or "attendant" depending on which the dial is on, an exchange or a

P.B.X. extension station. "0" or zero connects sub with zero operator in regular stations. The finger dial also carries a removable instruction and number plate fitted with a celluloid cover.

DESK STAND.

The desk stand to be used will be similar to that used in manual practice except that the post is mounted on a base designed to carry both the dial and the post.

WALL SETS AND COIN COLLECTION STATIONS.

Wall sets of the standard manual type may be converted to the panel Type Equipment requirements by removing the cover and replacing it by a new cover carrying a dial in addition to the transmitter. This may be done on the subscriber's premises or the manual set may be replaced by a new set equipped for this system.

SUBSTATION CIRCUITS. (Sketch #3)

The circuit is similar to the present standard circuit with the addition that provision is made for interrupting the circuit in accordance with the dialed number after the subscriber has closed it by taking the receiver off the hook, and also for the obviating noise while dialing is taking place.

The line circuit is carried through the impulse spring contacts of a switch mounted in the case of the dial. As the dial, and with it, the impulse wheel returns to normal after a number has been dialed, the circuit is opened at this contact by means of pressure exerted by the impulse panel on the impulse contact spring, the number of interruptions corresponding with the number dialed.

When the dial is out of its normal position, the receiver circuit is opened and the transmitter is short circuited in order to eliminate the variable resistance of the transmitter and make the line

condition more nearly constant while the impulses are being sent into the central office.

SELF TEST QUESTIONS

These questions are for the reader to use for testing his knowledge of the lesson.

ROTARY SWITCH.

- 1- Describe the construction of a rotary switch.
- 2- What is the terminal capacity of a rotary switch?
- 3- For what purpose is the first of the 23 sets of terminals used?
- 4- How is contact made with the brushes of the rotary switch?
- 5- In what way is the position of the rotary switch indicated?

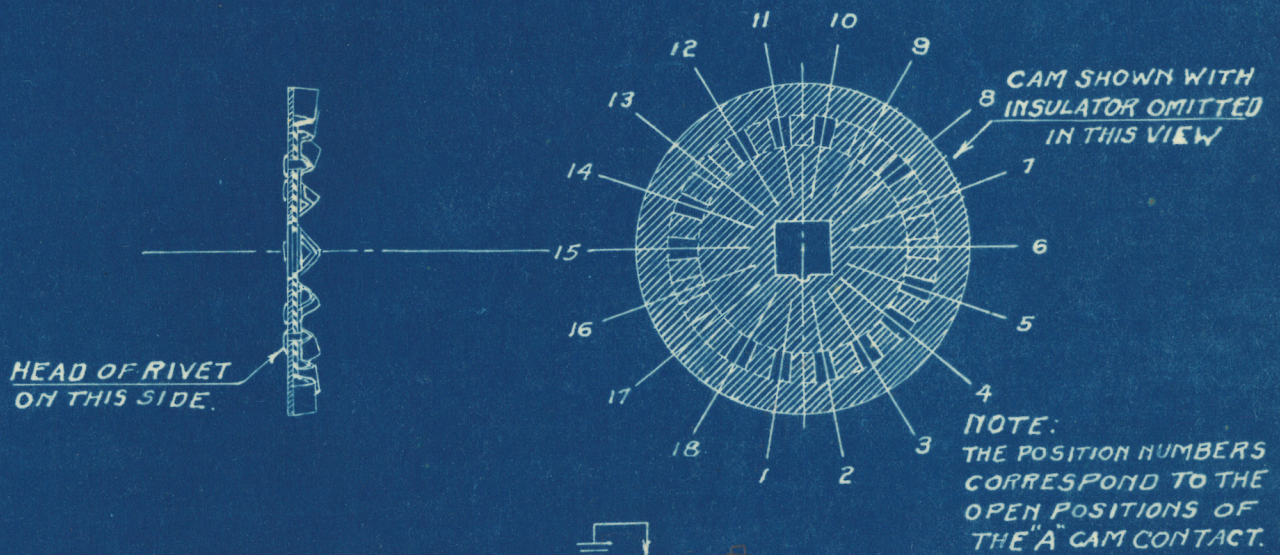
SEQUENCE SWITCH

- 1- What use is made of a sequence switch?
- 2- Give its construction.
- 3- How many positions may a sequence switch have?
- 4- How many cams may a sequence switch have?
- 5- What is an "A" cam? What is its functions?
- 6- In an 18 position sequence switch, how many degrees are there in each position? How many in a 20 position switch?
- 7- Give the position of the center of brushes.

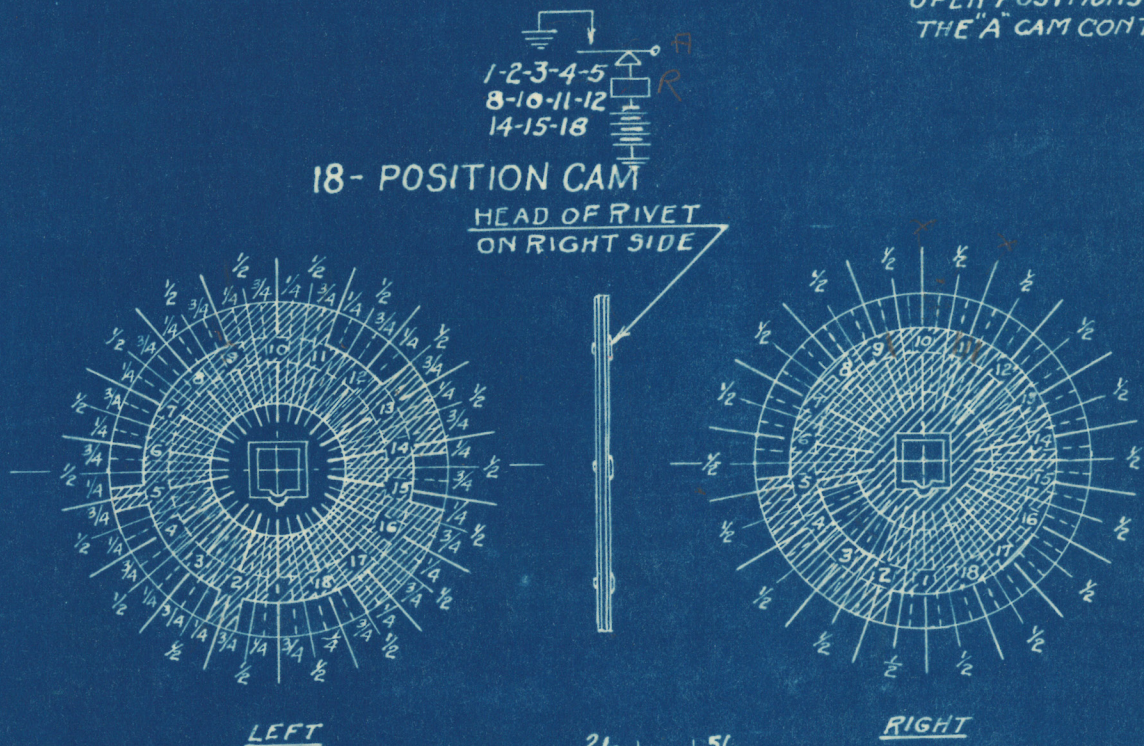
SUBSTATION EQUIPMENT.

- 1- What use is made of the dial?
- 2- How are the rates of interruptions controlled?
- 3- What are the normal rates of interruptions?
- 4- Explain the relation of the dial to the instrument circuit and its operation.

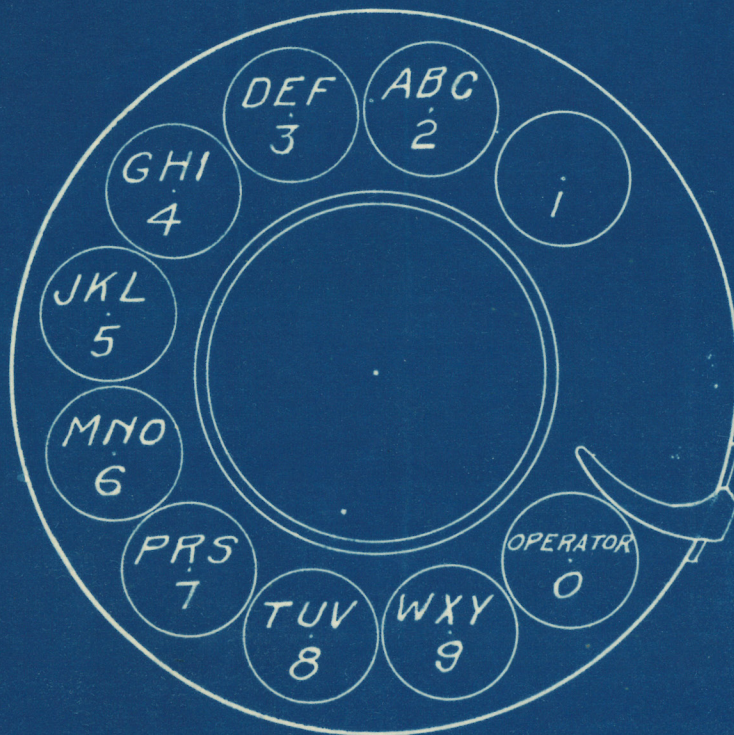
"A" CAM



18- POSITION CAM



LESSON-#4 - SKETCH #1



SUBSCRIBER'S DIAL
LESSON-#4 SKETCH-#2

PLANT SCHOOL

SEATTLE WASHINGTON

PANEL MACHINE EQUIPMENT

LESSON NO. 6

SUBJECT

REGISTRATION AND TRANSLATION

LESSON NO.6

REGISTRATION AND TRANSLATION

Two important fundamentals involved in machine switching are registration and translation. An analogy can be drawn between their functions in the machine switching and that of the operator in manual practice. The operator receives the desired number from the calling subscriber which she in turn interprets and sets up the connection. The register in the machine switching equipment receives the called number from the calling sub. via the dial, and records them on rotary switches. The translation then translates the settings of the registers into codes and makes the proper selections to establish the connection.

When the connection to the sender has been established, a highly sensitive relay is connected in the line circuit in series with the sub's dial and responds to the dial pulses. The relay is called the "L" line relay.

The "L" relay is operated from the loop of the sub's instrument and is released during the pulse periods sent from the dial.

In the fundamental registration circuit (sketch #1) the operation of the register circuit can easily be traced.

When the sender is connected to the line, the subscriber is informed by a dial tone which is transmitted to the line in an induced circuit. The tone circuit is closed through one winding

of the repeating coil: designated -BAL, through the normal contacts of the RC-4 are to ground at the contacts of the RLS-relay.

The operation of the "L" relay closes a circuit to operate the S.I.R. (slow release) relay. This relay is of the slow releasing type and remains operated during the pulse periods when the "L" relay releases. The operation of the SIR relay closes a circuit to operate the RLS (release) relay, which in turn closes the dial tone induced circuit through the normal contacts of the R.C.4 and the BAL coil to the tone circuit.

When the "L" relay releases from the first dial pulse the "A" register stepping magnet and the R.A. (Register advance) relay operate in series by a circuit from ground at the back contact of the "L" relay, front contact of R.I.S. winding of the R.A. normal contacts of R.C-6 are winding of A stepping magnet to battery: on this circuit the "A" switch is advanced one step for each dial pulse received. The R.A. relay which is of the slow releasing type operates only once and remains operated during the pulse period but releases during the longer period between the digits. It will be seen from this that the first number or letter dialed will be registered on the rotary switch of the "A" register.

When the R.A. relay operates the circuit of the R.C. (Register Control) stepping magnet is closed from the ground at the front contact of the R.A. through the winding of the R.A. stepping magnet to battery. This magnet is held energized until the release of the R.A. relay, when it advances the R.C. switch to position one.

When the "L" relay again responds to the dial pulses of the second digit, the B stepping magnet and the R.A. relay again

operate in series on a circuit from ground at the back contact of the "I" relay, back contact of the R.L.S. relay, winding of the R.A. through the number one contact of the R.C. 6- arc, through the winding of the "B" stepping magnet to battery. The "B" stepping magnet operates each time the "I" relay is released and sets the "B" switch to the number of impulses received from the dial. The R.A. relay operates only once and remains operated during the pulse period and releases during the longer interval between digits. When the R.A. relay operates a circuit is again closed to operate the R.C. stepping magnet as before and on its release the R.C. switch advances one point to position two.

The third digit is set up on the "thousands" switch by a similar circuit. When the "I" relay releases by the pulse from the dial during the third digit the R.A. relay operates once and the T.H. stepping magnet as many times as the "I" relay releases, the circuit is from ground at the back contact of the "I" relay - front contact of the R.L.S., winding of R.A. #2 contacts of R.C. 6 switch winding of T.H. stepping magnet to battery. From this it will be seen that the third digit or "thousands" will be registered or set up on the thousands switch.

When the R.A. relay operated on this circuit the R.C. stepping magnet was again energized as before and when released advances the R.C. switch to position three. It will be seen from this, how the leads are transferred by the operation of the R.C. stepping magnet through the R.C. 6 arc, to the hundreds, tens and units stepping magnet and the digits dialed set up on the switches.

TRANSLATION.

From the registration it will be seen that the digits as dialed will be set up on the arcs, the first digit on the "A" register, second on the "B" register, third on the thousands, etc. It will also be seen that the settings of these registers must be made to make the proper brush and group selections on the district and office frames, incoming and final frames and the final selection on the final frame. The first two, that is, district and office selections, are accomplished by the use of a power driven translator, called the rotary translator switch or #1202 type selector.

The banks and brushes are like those of a rotary switch and the driving mechanism like that of a sequence switch. It has two semi-circular banks of 22 terminal capacity each, which are mounted side by side. A frame is attached to these banks which carries the revolving member and the mechanism for controlling its rotation. The shaft carries two sets of single ended brushes, the contact points of which are set at 180 degrees from each other; that is while one set of brushes are passing over the terminals of its bank, the other set is clear of the other bank. The shaft is horizontal when mounted and has a flexibly mounted disc used for driving it and secured to it at the left hand bearing. The drive magnet is mounted beneath this bearing, with a small air gap between the magnet pole face and the face of the disc. The stop magnet is similarly mounted above this bearing. The translator is mounted adjacent to a constantly revolving vertical shaft and driving disc with a small clearance between this disc and the one in the translator shaft. When the drive magnet is energized the face of the flexibly mounted disc is held against the rim of the driving disc so that the friction between them rotates the translator.

shaft and the brushes mounted on it

Mounting the brushes at 180 degrees apart gives the translator switch a capacity of forty-four points

There are two such units in each translator assembly, namely translator one and translator two.

Each arc of terminals has a separate function to perform, and has a special designation. On the first, which is common to each translator, is the hunting arc and these arcs are multiplied to the terminals one to forty-four inclusive. The other five arcs on Translator No. 1 are designated: Beyond office, Office talk selector, Sender Delay and (SKO) skip office. The other five arcs on translator No. 2 are office group, office brush, district group, district brush and class. Each set of which sets up proper circuit functions to make selections which their names imply.

In the fundamental translator starting and setting (Sketch #2) the operation of the translators may be easily traced

When the R.C.4 switch reaches position 2, a circuit is closed to operate the S.T. relay (Start Translator) taking ground from the front contact of the RLS relay, point 2 or 3 of RC4 arc through the back contact and winding of the S.T. relay to battery and locks up through its front contact cam "O" of sender control circuit to ground at front contact of RLS relay.

The operation of the S.T. relay closes a circuit to operate the rotary magnets of the translators. Battery through winding of rotary magnets, back contacts of stop magnets to ground at front contacts of S. T. relay.

The energizing of the Rotary magnets draws the metal disc of the translator shaft in contact of the constantly revolving disc of the drive shaft and rotates the translator brushes wiping the terminals of the multiple banks.

When the brush wiping the terminals of the hunting arcs reaches the test terminal which is cross connected to the point on the B-2 arc to which the B registers have been set, a circuit is closed to operate the T.S.-2 relay and the STOP magnet in multiple battery through the windings of the T.S.-2 and STOP 2 in multiple, back contact of the T-R relay (transfer relay) brush of T.R.2 hunting arc terminals B 2 arc, A-3 arc, back contact of SSR relay, front contact of the R.L.S. relay. Energizing the STOP magnet opens the operating circuits of the rotary magnet and the translator comes to rest on the terminals desired. The operation of the TS-1 and STOP 1 are on the same circuit as the terminals of the hunting arcs are multiplied. At this point another holding circuit is established for the S.T. relay. battery through winding front contact Cam "O" to ground at front contact of the T.S.1 relay.

From this setting of the translator switch the proper counting relays are connected to make the proper selections and other arrangements that are necessary.

To give the translator switch access to all its terminals, a relay T.R. (transfer) is placed in the circuit, the operation of which transfers the leads from the STOP magnets to the brushes of the translator arc, having access to terminals #23 to #44. This relay is operated when the "A" register has been set on an odd number. The circuit for operating T.R. relay is, battery from winding of T.R. odd

terminals of A-2 arc back contact of S.S.R. relay front contact of S.T. relay to ground at front contact of RLS relay.

To allow use of the forty-four points on the translator switch from the two digit code registered on the A and B register it is necessary to wire these register arcs so as to stop the translator on any one of its terminals. (See sketch #4).

The terminals of the translator arcs T 1 and T 2 are connected in multiple 1 to 44 inclusive, this so that circuits for both stop magnets will be closed at the same point. As stated before, the brushes of the TR 1 and TR 2 which have access to the terminals 1 to 22 inclusive are set at angles of 180 degrees from those of the TR 1 and TR 2 which have access to terminals 23 to 44 inclusive. Settings on the "A" registers which are odd numbers will throw the brushes of the arcs T 1 and T 2 arcs which have access to the 1 to 22 terminals.

The forty different terminals of the B-2, B-3, B-4 and B-6 arcs may be arbitrarily cross connected to any point in the translator arcs. For example, take the number 22 or the prefix which will be dialed in case a Ballard number is dialed. The "A" register switch will be set on point 2 and the "B" register switch on 2 also. Then if the point 2 on the B-2 arc is arbitrarily cross connected to point 1 on the TR-1 even translator switch, it also is permanently tied to the point #1 of the TR 2 switch, they being in multiple. So that with the translator in operation the circuit of the STOP magnets would have been from the back contact of the TR relay the T1 and T2 arcs point #1 through the B2 and A3 arcs to ground. On the other hand, if the

code number dialed had been 32, it must take another point on the translator arcs, to take care of this and other codes whose first digit is an odd number, another lead is connected to the #2 point of the TR1 and TR2 arcs, but will be in the 23 to 44 group, and while it will be seen that the terminal in the T-1 and T-2 arcs of the first half are common, they will not be in the circuit as the brushes of these arcs are not in the circuit as the operation of the TR relay in odd A registration opens their circuit and closes the circuit of the brushes serving the last half.

The operation of the T R relay is from ground in odd terminals of the A 2 arc through the winding of the TR relay to battery.

The selections on the incoming frame require selections of trunks to the final frame which has a capacity of five hundred lines. In an office having ten thousand stations this will require twenty groups of trunks. These selections must be made by the numbers registered in the thousands and hundreds arcs, representing the thousands and hundreds digits dialed by the calling sub.

While these selections do not use the translator proper, they must be translated into the proper brush and group selections on the incoming frames. This is done by means of an I G relay, (Incoming Group).

The thousands 3 arc is so connected that the 0 & 1, 2 & 3, 4 & 5, 6 & 7, and 8 & 9 terminals are connected together and tied to counting relay leads. The 0 & 1 to counting relay 0, the 2 & 3 to counting relay 1, 4 & 5 to counting relay 2, etc. Thus it can be seen how the proper brush is tripped as in the bank to which the 0 brush has access are trunks which have access to the 0 to 1999, final frame. The #1- brush to the bank having access to the 2000 to 3999 final, etc.

The terminals 5 to 9 inclusive of the hundreds 3 arc are connected together and tied through the winding of the I.G. relay and as the brush of this arc is connected to ground, on hundreds 5 to 9 it will be seen that the I.G. relay will be operated and on terminals 0 to 4 inclusive, it will not be operated.

The thousands 6 arc has the odd terminals strapped together and the even terminals also strapped together. These straps are connected to the armatures of the I.G. relay.

Referring to the fundamental circuit (Sketch #3) of the incoming brush and group selection, this method of selection can easily be seen.

Assuming that the proper brush has been tripped, it will be seen that one of four groups of trunks must be selected. In each bank there are trunks which have access to two thousand final terminals, so in making this selection the thousands odd or even thousand, and the hundreds above or below five must be selected.

With the thousands digit an odd number and the hundreds below five it will be seen from the sketch that the I.G relay will not be operated, thus the lead from the thousands arc will be connected to the counting relay #2 or the third group will be selected. If the hundreds digit were above five, the I.G relay would have been operated thus connecting the lead from the TH-6 arc through the front contact of the I. G. relay to counting relay #5 and the brush would have selected the fourth group of trunks.

The same operation would have taken place for the even thousand digit, with this exception, the lead from the TH-6 arc even terminals is connected to the other armature of the I.G. relay which connects either the 0 or 1 counting relay which connects either the

first or second group of trunks. Taking any number then the proper brush and group can easily be determined.

SELF TEST QUESTIONS.

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- What are two important fundamentals of machine switching?
- 2- What is the purpose of the registers? Translator?
- 3- What piece of apparatus responds to the dial pulses?
- 4- What notification does the subscriber receive when the sender is attached?
- 5- Why is the R-A. Relay slow releasing?
- 6- In what order do the registers operate? What do they represent?
- 7- Through what medium is brush and group selection made?
- 8- How is the translator rotated?
- 9- What is the purpose of mounting the brushes 180 degrees apart?
- 10- What is accomplished by the rotary magnet?
- 11- When is the T R relay operated?
- 12- When does the I.C. relay operate?

FUNDAMENTAL REGISTRATION CIRCUIT
LESSON #6 SKETCH #1

COUNTING RELAYS

INC. BRUSH SEL.

4	9500	9	9999	3
	9000		9499	2
	8500	8	8999	1
	8000		8499	0
3	7500	7	7999	3
	7000		7499	2
	6500	6	6999	1
	6000		6499	0
2	5500	5	5999	3
	5000		5499	2
	4500	4	4999	1
	4000		4499	0
1	3500	3	3999	3
	3000		3499	2
	2500	2	2999	1
	2000		2499	0
	1500	1	1999	3
0	1000		1499	2
	500	0	999	1
	0		499	0

INCOMING FRAME
FIGURE-Nº 1

COUNTING RELAYS
INC. GROUP SEL.

COUNTING RELAYS
FINAL BRUSH SEL.

4	400	4	499
3	300	3	399
2	200	2	299
1	100	1	199
0	0	0	99

COUNTING RELAYS
FINAL BRUSH SEL.

4	900	9	999
3	800	8	899
2	700	7	799
1	600	6	699
0	500	5	599

FINAL FRAMES
FIGURE-Nº 2

INCOMING BRUSH SEL.
INCOMING GROUP SEL.

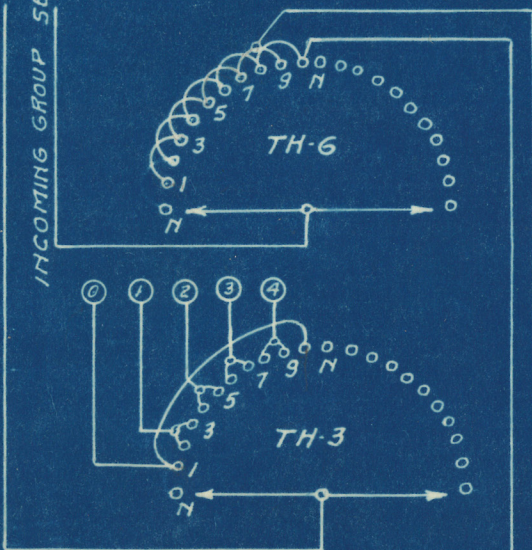
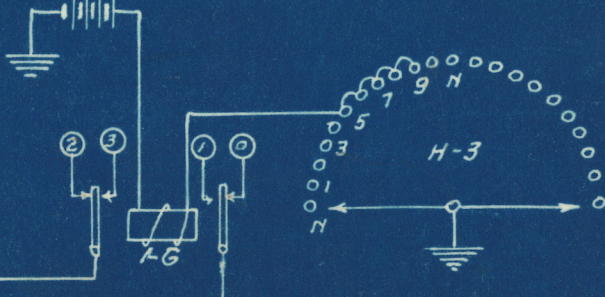
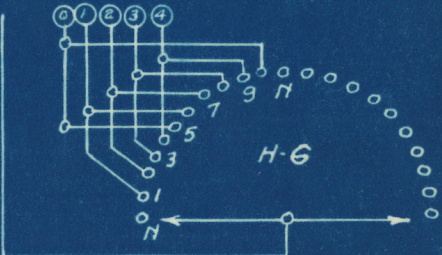


FIGURE-Nº 3

FINAL BRUSH SEL.



FUNDAMENTAL SEL. CIRCUIT
INCOMING BRUSH & GROUP & FINAL BRUSH SEL.
LESSON-Nº 6
SKETCH-Nº 3

PLANT SCHOOL

SEATTLE, WASHINGTON

PANEL MACHINE EQUIPMENT

LESSON NO. 7

SUBJECT

LINE FINDER, SENDER

FUNDAMENTAL OPERATIONS IN A COMPLETE CALL

PANEL TO PANEL OFFICE.

LESSON NO. 7

CIRCUITS - LINE FINDER.

Each subscriber's line is connected to a terminal that appears in a bank on a line finder frame. When a receiver is removed from the hook at a substation, a line finder to which is attached a district selector selects the associated terminal and then connects the switching mechanism to the line. When the sender is ready to receive and register the dial impulses a high-pitched tone known as the "Dial Tone" will be heard by the calling subscriber, the desired connection may then be dialed. The line finder frame is similar in construction to the district frame.

Each line finder consists of a vertical rod with fifteen sets of contact brushes which are wired in multiple. The line finder is of the line hunting type and the brushes start traveling in front of the banks of terminals when the lower end of the rod, called the "rack", is brought in contact with the mechanically driven friction rolls located at the bottom of the frame. Each line finder has access to fifteen banks of terminals containing twenty lines each which gives a total of three hundred lines. Each bank of terminals is split in the middle and the terminals reversed in the two halves, number zero terminal in the first half being number nineteen in the last half. The fifteen brushes on the line finder correspond to the fifteen banks on the frame. The line finders are assigned in rotation in each of the two halves, a finder in that half of the frame on which the calling

line appears on the lower terminals being started for the line as long as idle finders are available therein. The capacity of a frame is sixty line finders with thirty being located on each side, since the terminals project on each side of the banks. The frames may be so arranged that two frames can give three groups of forty line finders each, or that one frame can give two groups of twenty-eight finders each.

Selection is made mechanically by tripping the particular brush that is opposite the bank containing the terminals of the calling line. The brush is then driven over the terminals until it engages the terminals of the calling line.

If two calls originate practically simultaneously in any bank of terminals in the same sub-group only one line finder will start and it will pick up the line appearing on the lower terminal. A second line finder will then start and pick up the second or upper terminal. If two calls originate in the same bank but in separate subgroups, two line finders will start at the same time. Calls may originate in the different banks simultaneously and in this case the calls will be picked up in the order in which the brushes are tripped on the line finders. The order of selection between the banks will be changed after every call so that no one group will have a permanent preference. In this case, also where two calls come in simultaneously, only one line finder starts at a time.

The district selector circuit is provided with a sender selector. This sender selector is of the rotary type having a multiple bank consisting of twenty-two points and is driven by a magnet which breaks its own back contact so that the selector steps itself along in hunting an idle sender. The twenty-two points of the multiple are

connected to senders. The sender selector starts to find an idle sender as soon as the line finder is started.

The sender selectors operate on the "stay put" plan, that is to say, when the district selector circuit is dropped by the call, its sender selector remains on the terminals it is then occupying and does not return to normal. When the district selector is picked up for a succeeding call, the sender selector, if not on an idle sender, hunts for an idle sender from this position.

The district selector has access to a total of four hundred and fifty working multiple. Its multiple is divided into five banks of ninety working terminals each. Each bank may be assigned by groups of ten or multiples of ten to trunks leading out of the district selector. Some of the trunks from the district selector go directly to other offices, but since four hundred fifty multiple is not sufficient to care for all outgoing trunks some of the trunks may be carried to office selectors when more trunks are required.

The district selector has five multiple brushes, one for each bank. The method of selection is first to choose mechanically the multiple brush having access to the group of trunks desired and then to move the brush to the bottom terminal of the sub-group, then to hunt over this group until an idle trunk is found. If no idle trunk is found after hunting over the whole sub-group, the selector goes to a terminal called "overflow", the last of the group, and sends a busy signal to the calling subscriber.

The district selector like an "A" board cord circuit, has the usual repeating coil supervisory relays and in addition, various control relays and a sequence switch to control the circuit connections.

OFFICE SELECTOR

The office selector is divided with regard to its multiple in the same way as the district selector and selects a trunk in the same fashion. All the working multiple appearing on the office selector, however, is connected to outgoing trunks.

This circuit contains a control relay and a sequence switch.

SUBSCRIBER'S SENDER CIRCUIT.

The principal functions of the subscriber's sender are to receive the pulses from the sub dial, representing the called office and the called number in that office, and then to control the establishing of the connection. The sender is in use on calls to machine switching offices until the called line has been selected and on calls to call indicator offices until the desired number has been displayed before the call indicator operator.

The device used for recording the pulses as they come in from the dial, that is the registers, is a series of stepping switches of the rotary type as previously described. There is also a stepping switch called the register control which, after a series of pulses has been received and set up in the first register, shifts the leads to the next register and so on as previously described.

As soon as two sets of pulses representing the two digits or letters of the called office are received, a device known as the translator is brought into play to translate the settings of the first two registers into code to select brush and group on the district frame, and brush and group on the office frame. This method of operation has been covered in a previous lesson.

The counting relays of which there are a group of twenty-one in each sender, are the means used for controlling the selections made

by the selectors. Briefly, each selector as it moves makes pulses by means of its commutators. These pulses are counted by the counting relays and the sender stops the selector when the counting relays have received enough pulses in accordance with the setting of the translator when choosing a trunk or in accordance with the setting of the numerical registers when choosing a terminal in a panel office.

The class cross-connection tells the sender how to handle the call, ie: whether on full mechanical or call indicator basis, etc. The sender circuit also contains sequence switches and control relays.

INCOMING SELECTOR

The incoming selector is so called because it is attached at a machine switching office to the incoming end of a trunk. The incoming selector chooses a trunk to a final selector on which appears the line of the desired sub. The circuit includes a repeating coil, supervisory, ringing and control relays and a sequence switch. Selections on this frame have been covered in a previous lesson.

The final is, like the others, built with five banks of one hundred lines each, and in choosing a terminal, the proper multiple brush is selected in accordance with the hundreds digit, then one of ten groups in that bank in accordance with the tens digit and finally a particular terminal in accordance with the units digit. If the called number is a P.B.X with several trunks the selector hunts over the trunks to find an idle one. Associated with the final selector circuit are control relays and a sequence switch.

LINE FINDER EQUIPMENT.

Each subscriber's line is cabled from the vertical side of the I.D.F to a set of terminals in a multiple bank similar to the

multiple banks of a selector, except that each bank has a capacity of 20 four wire circuits instead of one hundred three wire. Power driven revolving friction rolls cause the selecting brushes, known as multiple brushes to move up over the multiple banks to find the terminals of the particular line originating the call and down again after the call has been completed.

The multiple banks, multiple brushes and associated apparatus are mounted in an iron frame work of the same general type as the framework of selectors. Each unit of the frame work has a capacity for mounting fifty-six or sixty selectors and fifteen multiple banks, one above the other, together with the associated driving mechanism, relays, resistance, etc. No sequence switches are required so that vertical driving shafts are not necessary. The subscriber's line and cutoff relays are mounted on relay bays located at the ends of the line finder frames, each bay having a capacity for relays for three hundred lines. The multiple banks may be arranged to terminate three hundred sub lines per frame, six hundred lines per frame or nine hundred lines per each two frames. In the first case, only one bay for line and cut-off relays is provided per frame. In the second case, two bays are provided, one at each end of the line finder frame. In the third case, one of a pair of line finder frames will be provided with two bays of relays and the other with one bay.

At the top of each multiple bank is a "comb". This comb is made up of several of the brass terminal strips corresponding to the "hunting" terminal strips, laid together without insulation. Its function is to establish a circuit to return the line finder to normal, if because of circuit failure or the abandoning of a call, the multiple brush should pass beyond the terminals of the line that

originated the call and continue to hunt until it passes the terminals of the top line. In this position the hunting spring of the multiple brush makes contact with the comb terminal and the line finder returns to normal.

The line finder commutators are similar in design to the commutators used on other selector frames. The segment "G" is connected to ground. The brush that makes contact with the "G" segment is strapped to the brushes that make contact with the C.K.X.N. & M. segments. Segments marked T.R.S. & H. provide means for making connection to the multiple brush springs. When the finder is in normal position commutator brushes make contact with the "G" & "N" segments. If a line finder should miss the terminals of a line that originates the call or the calling sub should abandon a call after the line finder has started and before it has reached the terminals of the calling line, it would continue to hunt upward until the brushes ran off the "N" segment and made contact with the "X" segment, and the multiple brush made contact with the "H" comb.

The connection with the "H" comb serves to stop the line finder as though it were the line calling and the connection with the "X" segment of the commutator serves to return the line finder to normal. If the line finder, through some circuit failure does not return to normal, after a period of time, the circuit to the "X" segment functions to bring in a "Tell tale" alarm and calls attention of the switchman to the condition. The "C" segment is called the "centering" segment. Its function is to raise the multiple brushes slightly beyond the position where the springs line up exactly with the multiple bank terminals and to allow the pawl of the clutch mechanism to engage in the slots in the rack of the brush support rod. When a line finder

brush spring reaches the terminals of the calling line, a relay operates and opens one path of the circuit through the drive clutch magnet, a second path is provided through the clutch magnet by means of the "C" segment of the commutators which is opened when the commutator brush breaks contact with the "C" segment. This occurs when the brush support has been raised sufficiently to allow the pawl to engage.

The start circuits of the line finder are so arranged that when one line finder has started to hunt for a line no other line finder in the same bank can start until the proper brush of the first line finder has been tripped except where two calls are originated in the same bank but in different sub-groups as described in further detail later. With this arrangement tripping mechanisms individual to each line finder brush support are unnecessary; horizontal trip rods are provided for each multiple bank, located on both sides of the bank and somewhat below the first terminal strip. Each trip rod, (located on one side of the multiple banks) carries a trip finger for each line finder in the group on the same side of the multiple bank. That is, if the frame is arranged for one group of sixty line finders, one trip rod carrying thirty trip fingers is provided on each side of each multiple bank. The trip rods extend across the frame in such a way that when revolved by their associated trip magnets, all of the trip fingers are placed in position to trip the corresponding brush of any line finder that starts to move upward. Thus when a subscriber removes the receiver from the hook and energizes the line relay, the trip magnet of the bank in which the terminals of the line are located is operated and a line finder is started upward to hunt for those terminals. The trip magnet revolves the trip rod and the trip-

ing trigger of the brush in moving upward engages with the trip fingers of this rod, as the line finder continues to move upward this brush is tripped so that its springs make contact with the line terminals.

A trip magnet is provided for each trip rod and is mounted on the frame work at the end of the multiple banks. So that all the trip fingers of any bank may be in position to trip any selector brush, two trip magnets are necessary; one on each side of the multiple bank and these magnets are operated in multiple.

GROUP DISTRIBUTION

Associated with each bank of line finders are two trip circuits, one for each sub-group of thirty in all. One group is called the "A" group, the other the "B" group. Since but one line finder in a group serving three hundred lines can be started to complete a connection at a time, with the exception noted above, several calls may originate while the start circuit is functioning and a brush is being tripped and some means must be provided to allot the sequence, in which waiting calls are to be completed. This is accomplished by a rotary switch known as a "group" distributor.

Referring to schematic sketch #3. With the distributor brushes in the first position, if two or more calls are waiting to be completed, one on a line the terminals of which are located in the first multiple bank, and the other on a line the terminals of which are located in some other bank, the connection of the line appearing in the first multiple bank is the first to be completed. When the brushes have been tripped in making this connection, the distributor brushes are advanced to the next position, giving the preference to any calls that may be waiting in the second multiple bank. For example, assume a call is originated on a line the terminals of which

are in the third multiple bank, and the distributor brushes are in the third position, as the subscriber lifts the receiver from the hook, the line relay operates, closing a circuit through the trip relay of the corresponding sub-group. The operation of the trip relay closes a circuit to operate the trip magnet and start relay of the starting circuit. The operation of the start relay causes an idle selector to start hunting for the terminals of the line.

If the brushes of the group distributor happen to be on position three, the circuit through the start relay would be as follows. From ground through six hundred ohm winding of #5 trip relay, contacts of #4 trip relay, contacts of #3 trip relay, contacts of group distributor in position 3, start relay battery.

However, if a call is also waiting on a line in the third bank, the #3 trip relay would operate and close the circuit of the start relay and open the circuit of the other trip relays and all other calls would be held up until the brush of the line finder started up to find the terminals of the line has been tripped. After the brush has been tripped, the brushes of the distributor are advanced to the next position, giving preference to any calls that may be waiting in that multiple bank.

This group distributor switch is provided with two arcs as indicated in the sketch, one arc for the "A" group and one for the "B" group. But whether call is completed to "A" or "B" group the selector advances both brushes to the next position, there being but one stepping magnet common to both start circuits.

In order to distribute the load evenly over all the line finders of the sub-groups, a selector distributing switch is provided for each sub-group of line finders. Referring to fundamental

sketch #4. the operation of this switch can be traced.

When the S.T.A. relay is operated (start relay circuit), it closes a circuit to operate the L.F. (Line Finder) Relay. The circuit is from ground at front contact of STA, back contact of G.A., back contact of C through jack, normal contacts of A-1 arc, back contacts of M.B. relay #1 to battery in winding of L.F. relay. The operation of the L.F. relay in turn closes a circuit to operate the G.A. relay. Operation of G.A. relay closes a circuit to energize the stepping magnet of the A-A arcs, and when starting circuit is released the switch advances one step or in position to assign line finder #2. This circuit is from ground at front contact of the S.T.A. relay, front contact of the G.A. relay #1 contact of A 3 arc to battery on winding of STP-A Magnet. Release of STA relay in start circuit opens this circuit and release of STP-A magnet advances the switch.

If a line finder on whose terminals the switch steps are busy, not having been released by a previous call, its M.B. relay will be operated. The next call will then be routed through its front contact to the next line finder. If that is also busy, it will be routed through its front contact to the next M.B. and so on until a non-busy line finder is found.

When the brushes of the A-1 arc have covered the terminals of its working line finders, the leads are transferred to the brushes of the A-4 arc in the following manner:

The brushes of the A-1, 2 and 3 arcs are set at an angle of 180 degrees to the brushes of the A-4, 5 and 6 arcs so that when brushes of the 1, 2 and 3 are wiping their terminals, those of the A-4, 5 and 6 are not engaged. The vacant terminals of the A-2 and A-5 arcs are bridged and connected to ground. This closes a circuit

to send the SIF-A switch to normal or until the circuit is opened at which time the brushes of the arcs 4, 5 and 6 are in the position to assign the first line finder in their bank. This arrangement gives one rotary switch a capacity of forty line finders.

If all line finders in Group A are busy the next call from the A group will be transferred to the line finders of the B group. This is accomplished by operation of the C.A. relay, which operates from ground through the chain contacts of all the M.B. relays of the A group (operated) and transfers the leads to the S.T.P.B. relay, and to its associated line finders of the B group. This is accomplished in the following manner referring to schematic sketch #5 on this subject. When the C.A. relay operates, it changes the routing of the lead from the T.R. relay to operate the S.A. relay. Take ground from winding of the T.R. relay in a trip circuit through front contact of T.R. relay, back contact of C relay, and operated contacts of the C.A. relay back contacts of S.B. relay in B start circuit, through the winding of the S.A. relay in the A start circuit to battery. This circuit operates the S.A. relay. The operation of the S.A. closes a circuit to operate the S.T.B. relay ground, back contact of C.B. relay, B start circuit front contact of S.A. relay and winding of S.T.B. relay to battery. Operation of S.T.B. relay functions to start a line finder in the B group hunting the terminals of the multiple to find the sub of the A group originating the call.

A similar circuit is established when all the line finders in the B group are busy.

If all the line finders in both groups are busy, a circuit is closed to operate the message register and record the overflow condition. Ground front contact of operated C.A. relay through the front contact of the S.B. relay through winding of MR. to battery. This circuit depends on the operation of overflow relay S.A. or S.B.

when both C.A. and C.B. relays are operated.

FUNDAMENTAL OPERATION ON COMPLETE CALL FROM
PANEL TO PANEL OFFICE.

When a subscriber removes his receiver from the hook, the L relay is operated over a circuit from ground at the contact of the cut-off relay marked C.O. through sub loop to the back contact of the C.O. relay through winding of the L relay to battery. The operation of the L relay closes a circuit from ground at its front contact through the winding of the trip relay, to battery on the back contacts of the S.T.P. magnet. The operation of the trip relay closes a circuit from ground at its front contacts through the winding of the trip magnet to battery, operating the trip magnet and placing trip fingers in position to trip the selector or line finder to start. Operation of the trip relay also closes a circuit from ground at front contact of the L relay through the second winding of the T relay front contact of the T relay contacts of the bank distributor switch and winding of the start relay to battery, operating the start relay. The operation of the start relay closes a circuit from ground at its front contact through the winding of the STP magnet of the group distributor and holds it energized. It also closes a circuit from ground at its front contact through the line finder distributor switch, the back contact of the M.B. relay, the winding of the T or L.F. relay to battery operating the L.F. relay. The operation of the L.F. relay closes a locking circuit for the L.F. by ground from the back contact of the H (Hunting) relay, winding of L.F. relay, front contact of L.F. relay second winding of L.F. relay to battery. Its operation also closes a circuit from ground at the brush of the N Commutator (which is grounded at all times) front contact of the L.F. relay and the winding of the updrive clutch magnet.

This causes the associated line finder to travel upward in search of the line terminals originating the call. The ground from the N commutator also operates the C.I. relay (cut in) in the district circuit. Ground N commutator front contact of L.F. relay, back contact of E relay winding of C.I. relay to battery. As the selector travels up, the brush of the M commutator makes contact with the M segment and operates the E relay, but a holding circuit is established for the District C.I. relay from the test wire of busy senders front contact of C.I. relay Cam S winding of C.I. to battery. The STP magnet of the sender selector is then energized from ground at the front contact of the C.I. relay winding of STP front contact of STP to battery. As this circuit is self-interrupting, the sender selector switch will continue to wipe the terminals of the sender selector switch until it finds a non-busy sender at which terminal the test wire will be open and the C.I. relay will release in turn releasing the STP magnet and stepping the selector switch on the terminals of the non-busy sender.

The operation of the E relay also closes a circuit to operate the M.B. relay from ground at its front contacts, winding of M.B. to battery, this makes the line finder test busy to other start circuits and opens the operating winding of the L.F. relay, but the L.F. is held over its locking circuit to ground at the back contact of the H relay and will be held up until the operation of the H relay. As the selector moves up the brush being tripped, its hunting brush makes contact with the H terminals of the multiple bank, all of which will be open except the one which originated the call. This terminal will have battery from the back contact of the C.O. relay, front contact of the L relay to the H terminal of the multiple bank. When the line finder reaches this terminal, a circuit is closed to operate the H relay, ground from winding of "H" relay, through the "H" brush of the

the line finder through the H terminal of the line, front contact of I relay to battery on back contact of the C.O. relay. The operation of the H relay opens the holding circuit of the L.F. relay and it releases in turn opening the circuit of the up-drive clutch which stops the line finder on the terminals of the busy line. The release of the L.F. relay closes a circuit to operate the S.L. (sleeve) relay in the district circuit. Ground from back contact of the L.F. front contact of E relay to battery on winding of the S.L. relay. The operation of the S.L. relay closes two circuits one to operate the C.O. relay, ground winding of C.O. over the sleeve wire to battery on front contact of S.L. operates the C.O. relay which releases the I relay. Release of I relay releases the trip circuit. The operation of the C.O. relay also takes the battery off the hunting terminal so it will not be seized by another line finder. The other function of the S.L. relay was to operate the District I relay, ground front contact of the S.L. relay Cam R winding of the I relay to battery. Operation of I relay closes a circuit to operate the sequence switch magnet and advance the district sequence switch to position 2.

In position 2 a local circuit is closed to operate the district C.I. relay battery from winding of the C.I. relay cam I to H to ground. The T relay in the sender control circuit, battery from winding of the T relay, front contact of T relay, back contact of O.N. relay, back contact, back contact of M.B. relay through test arc, front contact of C.I. relay to ground at S cam. The O.N. relay in the sender control then operates battery winding of O.N. to ground at front contact of T relay. The T relay is then held up by a circuit battery through winding of T, front contact of T, back contact of T-1 back contact of M.B. test arc, front contact of C.I. to ground at S

can The S.B. relay then operates on a circuit, battery winding of S.B. front contact of O.N. to ground at back contact of M.B. relay. The operation of these relays make the sender test busy to other sender selectors. The operation of the district C.I. relay closes the leads T.R., R.F. AND F.T. through to the sender and connects the I relay across the line.

The fundamental registration and translation circuit has been covered in Lesson No.6. So we will assume at this point that all the registers have been set and the translator switch stopped with the senders in position to make the district brush selection.

The fundamental selecting circuit is used to control the brush and group selections on the district, office and incoming selector frames and the brush, the group, and the individual line selectors on the final selector frame. The operation of the circuit is the same for making any one of the selections and the same equipment in the sender is used in all selections; that is, the stepping relay and the counting relays are used for making one selection, then released, and when the sender sequence switch reaches the next selecting position, are again used for making the selection.

For the operation of this circuit see Lesson No.5.

In central offices whose trunk capacity does not exceed the available trunk capacity of the district frame, office frames will not be used. To take care of the selection an arc S.K.O. (skip office) is connected in the translator circuit to the incoming brush selecting position. This is accomplished by holding the counting relays operated through the SKO arc and thus providing a circuit for the sender R magnet (sequence) switch to advance to the incoming brush selecting position. Selection of group and brush in the incoming frame have

been covered in a previous lesson, so we will pass to the final selections and ringing of called subs, bell or return busy back tone to calling sub, if called line is busy.

The final selector upon testing a subs line gets information as to how to proceed by the condition that it finds on the sleeve contact of the line. Upon testing a line not forming one of a P.B.X. group, it must be told whether the line is busy in order to know what to do next. If the line is idle it must seize it, making it busy to other calls, and then complete the talking circuit. If the line is busy it must drop the line promptly and send the busy signal back.

In case of the last line of a P.B.X. group, the final selector must proceed just as outlined above for a line not forming one of a group of P.B.X. lines. The last line of a P.B.X. group is therefore wired as an individual line.

In case of any P.B.X. line except the last one, on the other hand, if the selector finds this line busy, it must act differently, namely, hunt farther for an idle line. The sleeves of such lines are therefore wired differently in order to allow the final selector to distinguish them. The conditions on the sleeve are shown on sketch accompanying. In case of a direct line or last line of a PBX group, the sleeve terminal in the final multiple is wired to ground through both windings of the cut-off relay, but in case of the PBX line other than the last of the group to ground through the low winding of the cut-off relay only.

On the direct line of the last line of a PBX group that is busy, the sleeve terminal of the final multiple is connected to battery at the district selector through a 220 ohm resistance and is

connected to ground through the 1000 ohm and 100 ohm windings of the cut-off relay in series.

On a line of a P.B.X. group other than the last, that is busy, the sleeve terminal is connected to battery at the district through a 220 ohm resistance and to ground through the 100 ohm winding of the cut-off relay only.

The marginal relay in the final circuit marked PBX on the drawing is so adjusted that it will operate when the selector makes contact with the sleeve terminal of a busy direct line or last line of PBX group; but will not operate when the connection is made with the sleeve of a busy line of a PBX group other than the last one. This is due to the difference in resistance of the C.O. relay.

IDLE LINE

If the line selected is idle the final test circuit does not obtain battery from the sleeve of the terminal and the L relay releases. This makes the multiple terminal of the selected line test busy to other selectors and advance the sequence switch of the final selector to the talking position.

In case of a busy direct line or busy last trunk of a PBX the L relay receives enough current to hold the L relay and operate the PBX relay. This causes the final to be released and the busy signal sent to the calling subscriber. If the terminal selected is that of a PBX other than the last trunk and is busy, the L relay and the PBX relay receive current only enough to hold the L relay but not to operate the PBX. With this condition a trunk-hunting circuit is established and an idle line is hunted in the same manner as for other selectors. The L relay releases if an idle trunk is found and the multiple terminals are made busy and the final se-

lector advances to the talking position.

If all trunks are busy, on reaching the last trunk the P.B.X. relay is operated and functions to send the busy signal to the calling sub.

When the selection has been made on the final frame the sender is released and is available for another call.

RINGING SUBSCRIBER'S BELL.

It is assumed that groups 0 & 2 on the incoming frame are connected to final frames to which "one ring stations" are located and that groups 1 & 3 are connected to final frames, to which the "two ring stations" are connected. Thus, it will be seen that all the numbers in the 0 & 2 groups the ringing circuit must be to the one bell lead, and if in groups 1 & 3, to the two ring interrupter. This is accomplished by either stopping the sequence switch in position 13, the position when the one ring interrupter is connected to the line at the N cam incoming or advancing the sequence switch to position 16, which connects the two ring lead to the line at the same Cam.

OPERATION FOR ONE RING CODE.

With the incoming sequence switch in position 10, to which position it was advanced when the trunk to the final selector was selected, a circuit is closed to operate the incoming A relay. This circuit includes the winding of the C.S. relay in the district circuit but it does not operate as it is of the polarized type and this circuit passes through its winding opposite to that which operates it. This provides a circuit to operate the incoming L relay to ground at front contact of the A relay. The R-2 relay which closes the ringing leads to the line is then operated by a circuit through its winding to ground in front contact of the L relay. Operation of the R-2 re-

lay also closes a circuit to send the sequence switch to position 11, ground from contact of R-2 to the winding of the R magnet to battery. Positions 11 and 12 are by passed at the cam A the sequence switch advances through these positions to 13, one ring.

If the selections had been in the groups 1 or 3 the P commutator would have been grounded and would have provided a circuit to advance the sequence switch to position 14, and the circuit to ground at the front contact of the R-2 relay would advance it to position 15 in which position the two ring interrupter would have been closed to the line circuit.

With ground on the P commutator, as the sequence switch passes position 11-3/4, the R-2 relay is shunted out and it releases. Shunt circuit battery resistance Cam O ground at P Cam. In position 13 a circuit is closed to advance the sequence switch to position 14, battery winding of R magnet Cam O to ground on P commutator. In position 14 a circuit is closed to operate the R-2 relay a second time. Battery through resistance back contact of R-1 winding of R-2 Cam F, Cam P through the 40 watt 600 lamp to the P V interrupted ground. The R-2 relay locks through its front contact to the front contact of the L relay as before and closes a circuit to advance the sequence switch to position 15 (2 bell choice). Battery winding of R, Cam B to ground at front contact of the R-2 relay.

The release of the R-2 relay by a shunt to the P commutator is designed to prevent any false 1 ring impulse to go out on the subs link.

The circuit for ringing subs bell is the same in both cases.

To assure the calling subscriber that the called number is being rung an inductive ringing tone is established by a circuit from

generator at H cam, winding of R-1 relay, through a condenser the front contact of the R-2 relay over the tip of the line to 4 & 3 winding of the repeating coil to ground.

When the called subscriber answers the R-1 relay which is bridges across the line in series with the ringing power, operates and functions to open the circuit of the R-2 relay which releases and closes the talking leads through. Closing this circuit through operates the C.S. relay (call supervisory) of the incoming circuit which in turn causes operation of the C.S.1 relay which reverses the circuit back to the district and operates the polarized C.S. relay in the district circuit and operates the C.H. relay in the district. Operation of the C.H. relay makes circuit arrangement so that subscribers will be charged for the call in case of measured service or coin collect service.

The disconnection is controlled entirely by the calling subscriber and will be covered in subsequent lessons and methods of operations.

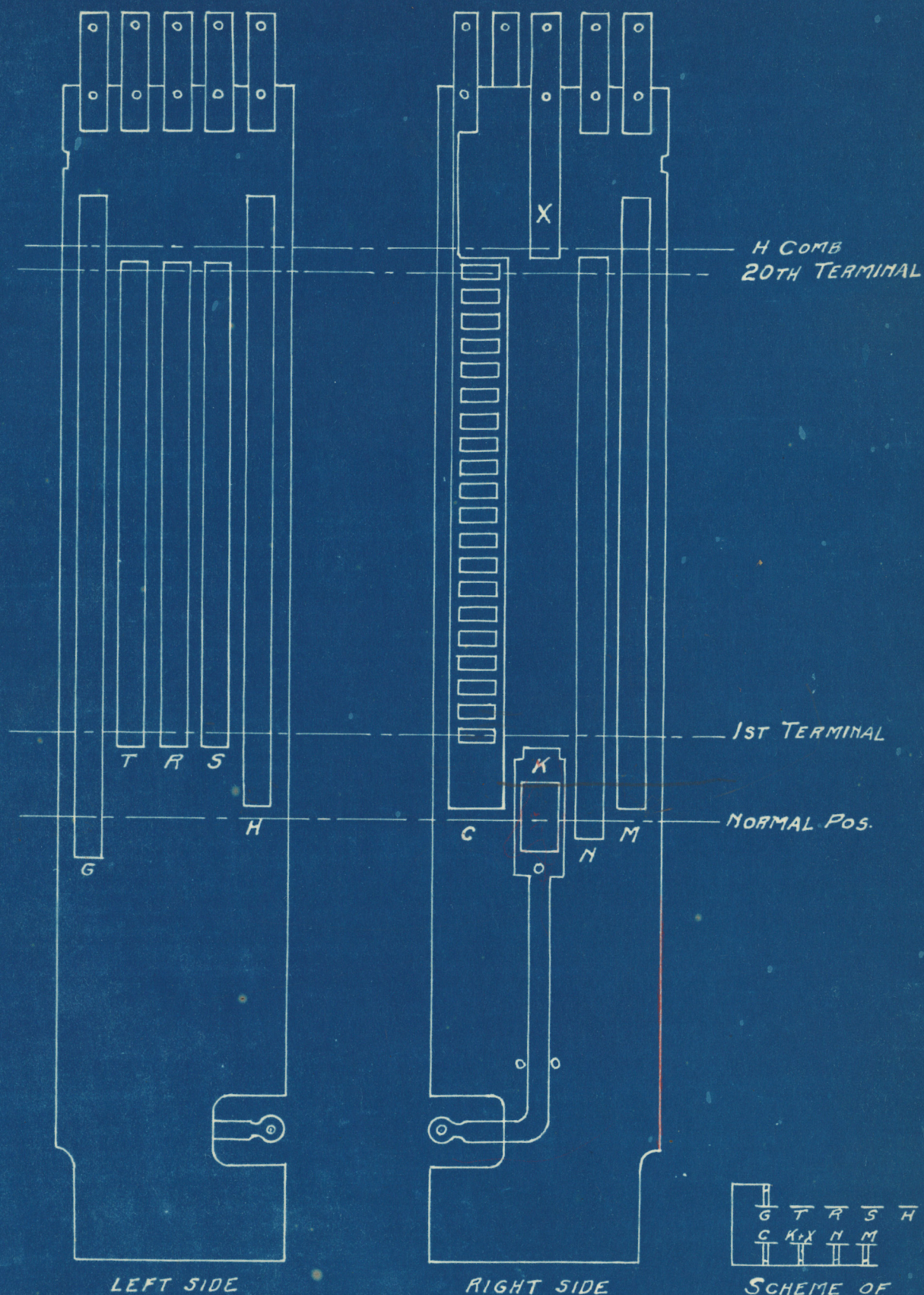
Before the actual tracing of circuits one must familiarize themselves with the circuit conventions which are illustrated in Sketch #10.

SELF TEST QUESTIONS.

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- What follows when a receiver is removed from the switchhook?
- 2- What does each line finder consist of?
- 3- How many lines does each line finder have access to?
- 4- How many banks in a line finder frame? How many lines in a bank? How many lines in the frame?
- 5- What is the capacity of a line finder frame as regards to selectors?
- 6- How is brush selection made?
- 7- If two calls originate simultaneously in any bank of terminals in the same sub-group, will they both receive service at the same time?
- 8- Define a sender selector.
- 9- How many lines has a district selector access to?
- 10- How is the multiple divided?
- 11- How is selection made on the district frame?
- 12- What equipment has a district selector similar to an A board cord circuit?
- 13- What is an office selector? Why used?
- 14- What are the principal functions of a subscriber's sender?
- 15- What are registers? How used?
- 16- What is a translator? What is its purpose?
- 17- What are counting relays?
- 18- What is a class arc?

- 19- What is the purpose of an incoming frame?
- 20- What is a final frame?
- 21- Describe in full Line Finder Equipment.
- 22- Describe a Line Finder Commutator.
- 23- What are start circuits?
- 24- Describe the tripping mechanisms.
- 25- What is meant by group distribution? How used?
- 26- If all line finders are busy in group A, what results?
Also B group?
- 27- What happens if line finders are busy in both groups?
- 28- Give the fundamental operations of a call from mechanical
to mechanical in your own words in a general way.
- 29- Describe the busy test on a final frame.
- 30- Discuss ringing the subscriber's bell.
- 31- How is the disconnection controlled?



MACHINE SWITCHING SYSTEM PANEL TYPE

LINE FINDER COMMUTATOR

LESSON № 7 - SKETCH-#2

LESSON-#3 ~ SKETCH-#3

PLANT SCHOOL

SEATTLE WASHINGTON

PANEL MACHINE EQUIPMENT

LESSON NO. 11

SUBJECT

OPERATOR'S CIRCUITS

"A" OPERATOR'S CIRCUITS

"A" Operator Key Sheet	ES-226652
Manual Cord Circuit	ES-226618
Outgoing Trunk	ES-226203
Operator Dist. & Sender Sel.	ES-226612
"A" Supervisor Circuit	ES-226204
Desk Line	ES-226207
Zero Operating Trunk	ES-226194
Verifying Trunk	ES-22695
Intercepted Blank	
Final Trunk	ES-226196
Blank Incoming Trunk	ES-226197
Master Ringing Keys	ES-207789
Auxiliary Signal & Night Alarm Cct.	ES-207826

LESSON NO. 11

ZERO OPERATOR POSITIONS

GENERAL

1. A suitable number of Manual positions will be installed in each panel office for completing such local calls as may be necessary due to the inability, for any reason, of subscribers to complete such calls themselves. These positions will also be used for giving out such information as may be found necessary, and for connecting subscribers through to certain central office desk operators which they will be instructed to call through the zero operator.

2. Subscribers will obtain connection with these positions by dialing zero. The word "Operator" will be written in the zero space of the dial as an aid to subscribers. The zero operator can be called from the coin box stations in panel offices without depositing a coin.

3. In certain offices, the three-slot prepayment coin box lines and the subscriber's lines from which toll calls are refused, will be terminated on regular subscriber's answering jacks at the zero positions. All calls originated on such lines will be handled manually by the zero operators. It will be necessary to deposit a coin to call the zero operator from these manual coin box lines. The automatic return of the coin, in case it is not collected or returned by the operator, is not provided for.

KEY BOARD EQUIPMENT (SEE SKETCH #1)

4. A dial will be provided at each position. Regular "A" board equipment, consisting of a back and front row of cords with an

associated supervisory signals will also be provided. The back cord will be equipped with the automatic audible and flashing recall. Each cord circuit will be equipped with coin collect and return keys. These keys will be of the plunger type. Immediately in front of these keys will be two double throw lever keys. Wiring will be provided for the installation, if required, of four master ringing keys of the plunger type to be located in the right hand side of each position.

5. The arrangement and operation of these keys will be as follows:

Keys Per Cord Circuit

- O- Coin Return Key
- O- Coin Collect "
- A- Dialing Position Key (locking)
- B- Flashing position, when operated
alone (non-locking)
Ringing position when operated in
connection with Master Keys.
- C- Listening position (locking)
- D- Ringing position to ring over trunks
through special incoming se-
lectors. (Party lines on a
terminal per station basis)
Non-locking.

Master Ringing Keys Per Position

- O- To ring back on individual lines and
the first party of two and
four party lines.
- O- To ring back the second party of two
and four party lines.
- O- To ring back the fourth party of four
party lines.

6. In order to ring back on an individual or party line, it may be necessary to call the number of the station to be called back.

In completing a reverting call, it will be necessary for the calling party to hang up while the zero operator rings the called station.

7. For dialing, listening and ringing forward through the special incoming selectors the keys are operated as shown in paragraph No. 5.

8. A peg count register key will be provided on each position.

FACE EQUIPMENT

9. The following groups of trunks will terminate at the zero positions in answering jacks with associated lamps, designation strips and number plates.

North, Rainier and West

Incoming Trunks

- (a) Flat rate and Message rate unlimited from District multiple.
- (b) One slot coin box unlimited from District multiple.

10. Calls for the zero operator originated on lines of the classes given under paragraph No. 9 will be routed over the corresponding groups of trunks.

SUBSCRIBER ANSWERING JACKS

11. A few regular subscriber's answering jacks (see paragraph 3) will be provided at the zero positions on which lines of the following classes will be terminated:

North, Rainier and West

- (a) Miscellaneous
- (b) Three slot prepayment coin box unlimited
- (c) Flat Rate refused Toll
- (d) Message Rate refused Toll
- (e) One slot coin box refused toll.

(Note: Miscellaneous (a) for lines not otherwise provided for, which it may be necessary to handle manually).

12. Calls on these manual lines will be originated in the same manner as by subscribers in manual offices; at the one slot and three slot coin box manual lines, it will be necessary to deposit a coin to call the zero operator. These calls will be handled manually by the zero operator. The lines will, however, be connected to Final terminals and incoming calls will be routed to them the same as to regular panel office stations.

OUTGOING TRUNK MULTIPLE

13. An outgoing trunk multiple, common to the zero and intercepting operators, will be provided to which will be connected trunks of the following type:

- (a) A group of dialing trunks, common to all positions, and terminating on operator's District Selectors.
- (b) A group of dialing trunks, common to all positions and terminating on Special Incoming Selectors

These special incoming selectors will be wired so that if the "No Test" key is operated the final selector will go in over the busy test. The ringing will not start until the operator operates the ringing key.

- (c) Automatic signal trunks to various desks such as Chief Operator, repair clerk's desk, etc.
- (d) Automatic signal trunks to toll recording positions.
 - 1. To Pac.Co. particular person recording positions.
 - 2. N.W.L.D. Co. " " "

METHOD OF OPERATION

(Call not completed. See method of operation 1-2-3).

GENERAL

14. Panel office subscribers who desire to give "My bell rang" reports or to obtain information to assist them in completing calls, will dial the zero operator. The zero operator will plug in to the answering jack of the trunk selected with the back cord (as in manual practice), and give the desired information. The arrangement of the equipment will be such that the call will not be registered if the call is from message rate line, when the calling party hangs up. If the call is from a coin box line the operator will depress the return key; if she fails to return coin, it will be returned automatically when the calling party hangs up and the operator disconnects.

LOCAL CALLS

15. Zero operators receiving calls from panel office subscribers for a local number will make a reasonable effort to have the subscriber complete the call himself but failing in this, the operator will connect the front cord of the pair used to the jack of an idle dialing trunk terminating in a District Selector, operate the dialing key and then dial the number desired. The connection is handled exactly the same as calls dialed by subscribers, except that the "A" operator supervises the call.

16. It is expected that there will not be many calls completed through the zero positions and there probably will be no serious objection to letting the few from message rate stations go through free, as the operator will not know whether calling station is on a flat rate or a message rate line.

On calls for local numbers received over the Manual subscriber's lines mentioned under paragraph No. 11, the zero operator will plug in, answer and take the order in the same way as done by "A" operators and will follow "A" operating methods with regard to ticketing on message rate lines and collecting or refunding the coin on coin box lines. The operators will complete such calls over dialing trunks terminating on the zero operator District Frame.

18. Calls for the Chief Operator, Complaint Desk or Operator, Wire Chief, Chief Switchman and Repair Clerk, will be completed by the zero operator directly in the outgoing trunk multiple of the automatic signal trunks extending to the desks. On calls for "Information", the zero operator will dial the regular code for "Information".

19. Where it is necessary to call two stations by dialing and then establishing a connection between them, as in a delayed call, the zero operator will dial both stations in the regular way, calling one of the stations with the front cord of one pair and the other with the front cord of the other pair. When ready to connect the stations together, the operator will plug the back of the pair on which station (a) is held into an adjacent multiple of the jack on which station (b) is held. The front cord of the pair used in dialing station (b) can then be taken down without losing the connection to that station.

LONG DISTANCE CALLS

20. If the zero operator receives a call from a subscriber entitled to toll service or Long Distance and he refuses to dial the corresponding code after being requested to do so, she will connect him to the proper recording board by means of the recording trunks

mentioned in paragraph 13 (d).

21. Should a call be from a refused toll subscriber for long distance, she will notify him that toll connection cannot be made from that station. If he states that he desires to place a collect call or that he has been requested to call a certain operator, she will call the proper recording operator using a split connection, and notify recording operator that the call is from a refused toll station, and then connect the party to the toll operator

22. If a call is received from a three slot coin box line for Long Distance, the zero operator will advise the recording operator as to the class of line calling before connecting the calling party.

23. The zero operator will receive direct supervision from the calling station on all classes of calls. On calls from all classes of panel office stations the disconnection of the calling line will be controlled by the combination of the switchhook at the calling station and the cord of the operator.

24. On calls to numbers in panel offices or in manual offices equipped with call indicator B positions the zero operator will obtain direct supervision on the called station, if that station is one to which calls are ordinarily charged for, when made from a message rate or coin box line. If calls to the called number are free, the zero operator will not receive direct supervision but the front supervisory lamp will continue to burn during the conversation the same as if the call station were being rung.

25. On calls to busy lines in manual offices reached over call indicator trunks, and on calls to busy lines in panel offices

the front, supervisory lamp of the zero operator will flash and the calling party will hear the busy tone.

26. On calls to manual offices, the call indicator trunks which are routed by the "B" operator to the Intercepting, Trouble or Rural positions, the front supervisory lamp of the zero operator will not be retired by the answer of the operator at such positions. This will make it necessary for the zero operator to supervise carefully on calls from coin box lines in order that she may know whether the deposited coin should be returned or collected.

27. On calls to central office desks completed by the zero operator over outgoing automatic signal trunks, the zero operator will obtain direct supervision on the called desk operator.

28. On calls to toll recording positions completed by the zero operator over outgoing automatic signal recording trunks, the zero operator will obtain direct supervision on the recording operator.

29. Subscribers in a panel office desiring to have a cut-off restored or a "Busy" or "Don't Answer" condition verified will call the zero operator. In case the call is for a number in another office, the zero operator will call the intercepting operator in that office, who will give her the status of called number. If the intercepting operator obtains the desired number she will connect it to the trunk of the zero operator who will complete the call to the calling subscriber.

30. If the call is for a number in her office, the zero operator will consult her condensed numerical record to find out whether

the called number is one of an associated P.B.X. group and will then proceed as described in the following paragraphs.

31. If the called number is one of an associated group, she will connect the front cord of an idle pair to the jack of an idle dialing trunk terminating in the District Selector of her office operate the dialing key and then dial the lowest number of the group including the office designation. If the busy signal is received she will release the trunk and advise the calling party that all trunks in the group are busy. If the busy signal is not received she will be connected to the called number and when the called party answers the operator will connect him to the calling party.

32. If the called number is not one of an associated group the operator will connect the front cord of an idle pair to the jack of an idle trunk terminating in one of the Special Incoming Selectors. Operate the dial key and the "No Test" key and then dial four digits, (omitting the office designation) of the called number. The Zero and Intercepting operator's sender works in conjunction with the special incoming selector and the switching mechanism will establish a connection to the number, regardless of whether or not it is busy, (as the operation of a N.T. key allows the selector to stop on the terminals of the line called in case it is busy), but ringing will not start automatically. The operator will supervise and if a conversation is heard, she will determine what action is to be taken. If no conversation is heard, she will challenge. If the line is not in use she will operate her ringing key. If the called party answers after a suitable explanation, she will connect him to the calling party.

INTERCEPTING POSITIONS

GENERAL

A certain number of switchboard positions will be provided in panel offices, to which will be connected calls for numbers which are affected by irregular conditions, such as changed or disconnected numbers or numbers the calls for which are being temporarily transferred. At all offices, except Main and Elliott, the intercepting positions will be in line with the zero positions.

KEYBOARD EQUIPMENT

The keyboard equipment on these positions will be the same as that on the zero positions, except that at the first two intercepting positions at Main, a smaller number of cords will be provided and the coin collect and return keys will be omitted. The flashing keys will enable the intercepting operator to flash in manual operators, since the front supervisory signal on these operators' cord circuits will not be retired by the answer of the intercepting operator.

PAGE EQUIPMENT

A number of trunks from the inter-mediate frame will terminate in answering jacks, with associated lamps, designation strips and number plates on the intercepting operators' positions. All final terminals to which calls are to be intercepted will be connected to these trunks. Also certain final terminals over which calls from other operators will regularly be routed will be connected to certain of these trunks to these answering jacks. The outgoing trunk jacks appearing

in front of the zero operators will be extended through the intercepting operators' positions.

METHOD OF OPERATION

GENERAL

If the calls to a station are to be intercepted, the frame man will connect by suitable means at the intermediate distributing frame, the terminals of this line to a trunk terminating in an answering jack in front of the intercepting operator. If the station so connected is called, the call will be routed to the intercepting position over this trunk and the associated line lamp will be lighted.

The different type of calls which will be received will be handled as follows:

(a) Changed and discontinued numbers will, in general, be connected to individual trunks, unless abnormal conditions cause the number of lines of this character to exceed the number of trunks provided, in which case two or more of these lines may be connected to one of these trunks. The intercepting operator on receiving a call on one of these trunks, will ascertain the status of the called line from the information shown on the number plate and designation strip, or if this is insufficient, from her numerical records. She will then advise the calling subscriber or the calling operator (as the case may be) of the status of the called line, and request the subscriber or operator to take the proper action toward completing the call, if it is one that can be completed. If the intercepting operator disconnects from the trunk while the calling subscriber or operator is still connected to the trunk, the line signal on this trunk will not re-light.

(b) If the intercepting operator on receiving a call on one of these trunks, finds from the designation or records that the call is for a temporarily transferred number, or for a line on which the service is being intercepted on account of directory error, or for other reasons, she will advise the calling party of the temporary number of the called party and request him to call this temporary number.

(c) Vacant lines will, in general, be grouped and connected to one or more of the trunks appearing in front of the intercepting operator. Where a complete group of one hundred consecutive numbers is vacant or several such groups are vacant, they may be connected to one trunk, the designation strip above the answering jack showing the group number. Scattered vacant numbers may be connected to certain answering jacks provided for, to individual trunks. Blank choices will be connected to certain answering jacks provided for that purpose. If the intercepting operator receives a call on one of these trunks and finds from the designation strip, or from her records, that the call is for a vacant line, or a blank choice, she will so advise the calling party and if necessary, connect the calling party with the Information Desk.

RESTORING CUT-OFFS AND VERIFYING "BUSY" AND "DON'T ANSWER" REPORTS

If the intercepting operator receives a cut-off report from an operator or supervisor, or a request for the verification of a "Busy" or "Don't Answer" condition, she will consult the condensed numerical record in order to find out whether the called number is one of an associated P.B.X. group; and will then proceed, as outlined for the zero operator, to obtain the desired number. She will, how-

ever, be dealing with a calling operator, instead of a calling subscriber. If a call in connection with a cut-off is received from a toll operator, the intercepting operator, after obtaining connection with the desired number, will request the subscriber to hang up and will then advise the toll operator, flashing her in, if necessary, that the line is available.

At the time of the cut-over there may be a need of a few additional positions for intercepting operators. In offices where cordless "B" boards are in operation, the calls for stations in her office will be set up by the cordless "B" operator by an order over a call wire by the intercepting operator. The Cordless "B" operator will assign trunks which terminate in a multiple before the intercepting operator.

BLANK INCOMING TRUNK CIRCUIT FROM INCOMING FRAMES (See D-ES-226197)

These trunks extend from the Incoming Frame multiple bank to the Intercepting Operator positions and terminate on answering jacks. Where a complete group of five hundred consecutive numbers is vacant they may be connected to a Blank Incoming trunk. When the selector on any incoming frame is moved to a blank choice, the L relay in the trunk to the intercepting operator position is operated, which in turn operates the sequence switch, the R.D. relay operates through low speed interrupter. The R.D. relay is held operated allowing the T.K. relay to operate. As the R.D. Relay releases at the opening of interrupter, its back contact closes a circuit to operate the C.O. relay which in turn closes a circuit to light answering jack lamp of this trunk. At the operation of the C.O. relay, the L relay

is released. The intercepting operator plugs into trunk. This action operates the sleeve relay (SL), extinguishing the lamp; on the removal of plug from trunk jack the SL relay will remain operated until the incoming frame sequence switch advances removing ground from sleeve which releases TK relay.

VOLTMETER CORD

For verifying "Don't Answer" reports a single ended voltmeter cord is provided, usually at only one of the positions (Intercepting). It is equipped with a supervisory lamp and two keys, (a) Reversing Key and (b) Listening In key.

COIN COLLECT OR COIN RELEASE

If the call is from a coin service line and is completed by zero operator, she will depress the coin collect key.

X 110 volt battery through lamp CC relay contact of key contact TRP relay to tip of line, at the depression of C C key.

*TRP relay contact of C C key operates the TRP relay cutting off repeating coil and other circuits at the operation of the CC relay the coin lamp is lighted as in manual practice.

For coin release the same circuit functions take place except battery is sent out over the tip of line at depression of CR key.

There is a position register circuit connected with the CC key which operates a message register relay and lights an associated pilot light.

In case the zero operator fails to collect or return the coin if one was deposited it will be returned automatically when the

calling party hangs up and the zero operator disconnects.

The flash relay (FL) is operated by the Answer Cord ringing key which operates FL relay which in turn holds other relays in circuits operated during flashing period.

METHOD OF OPERATION OF A CALL TO THE ZERO OPERATOR (FLAT RATE)
TRUNK CIRCUIT ES-226194 - CORD CIRCUIT ES-226618

The district sequence switch is in position 13 awaiting operator, at this time a circuit is established from battery at and through the I relay, back contact of the CO relay, tip side of the line, F cam (Dist) #4 and #3 repeating coil, W cam winding of the CS relay (CS does not operate), X cam, #8 and #7 repeating coil, G cam, ring side of the line, back contact of CO relay, winding of I relay to ground.

The I relay operates, which closes a circuit from battery through the TB relay, front contact of the I relay to ground. Operating the TB relay the calling subscriber receives ringing tone.

The operation of the I relay also lights the trunk lamp.

The zero operator inserts answering cord into trunk jack, which operates the MGA, SIA and CO relays, taking battery through the winding of the MGA relay through the winding of the SIA relay, sleeve of cord, sleeve of jack, winding of the CO relay to ground. Releasing the I and TB relays also extinguishing the trunk lamp.

The operation of the MGA relay closes a circuit to operate the SA relay. Taking battery from and through the winding of the SA RELAY, front contact of the MGA relay, through #6 and #5 of the repeating coil over the ring side of cord and line, through the subscriber's station over the tip side of the line #2 and #1 of the repeating coil to ground at the MGA relay. On the above circuit the CS relay in the Dist. operated moving the District Sequence Switch into position #14 (Talking to Operator). In passing position 13½ the

CS relay releases. The supervision is controlled by the Zero Operator's Cord Circuit; the repeating coil in the Dist. is not used.

The supervisory lamp on the cord circuit is shunted out by the operation of the SA relay, the shunt path is from battery at the back contact of the PS-1 relay, the winding of the PS relay, back contact of the L relay, back contact of the FR relay, front contact of the SA relay, back contact of the FR relay, 40^W resistance, 120^W resistance, front contact of SLA relay to ground. There is also a buzzer circuit and interrupter flash in connection with this circuit. Zero Operator throws listening key, operating L relay battery through the winding of the L relay to key contact to ground.

The operation of the L relay closes a circuit to operate the CO relay. Taking battery through the winding of the CO relay, front contact of the L relay, front contact of the MGA relay, to front contact of the SLA to ground. The CO relay locks through its own front contact.

The operation of the CO relay closes a circuit to operate the T relay which cuts in the zero operator's set and also closes a circuit to operate the FR relay. Battery through the winding of the FR relay, contacts of the listening key, front contact of the CO relay to ground. The FR relay operation shunts out supervisory cord lamp through its 40^W winding, and locks up on its own front contact.

On calls coming into the Zero Operator from the Incoming Frame where ringing power is used, the cord circuit is arranged to trip the ringing relays at the incoming frame in a case of failure, etc. from the operation of the TR., C., C-1 and TRP relay. Now the

Zero Operator talks to the subscriber and gives him the information required; if this satisfies subscriber, he hangs up and the apparatus at the mechanical office is returned to normal. If the condition requires the Zero Operator to complete a connection for the subscriber she will insert the calling cord plug into the outgoing trunk jack. Operate the dial key, the MGC and SLC relays will operate from a circuit of battery, winding MGC relay, winding SLA relay to sleeve of jack through 37^W resistance to ground. On receiving dial tone the Zero Operator will dial the desired number. Release the dial key, which will allow battery and ground to be placed on the ring and tip of line, the core supervisory lamp will burn, battery from lamp back contact of SC-1 relay, back contact of the SC relay to ground at the front contact of the SLC relay. When the called subscriber answers the SC-1 relay operates, opening the lamp circuit.

On calls to desks, or on lines where the sleeve resistance is 500 ohm the MGC relay does not operate. In the calling cord circuit the SC relay controls the supervisory lamp. It is a polarized relay.

BLANK CHOICE TRUNK CIRCUIT - ES-226197

When the incoming sequence switch is in position 13 (Ring- ing and Talking) a circuit is closed to ring up the I relay in the Blank Incoming Trunk Circuit. Its operation closes a circuit to operate the sequence switch of trunk circuit, moving it from #1 position to #1 position. At the same time the I relay operated it closed a circuit to operate the RD relay; the RD relay holds up to the low speed interrupter and the sequence switch in moving from #1 position to #1 position sends back pulses to the sender to satisfy it (See note). These pulses are made possible from the battery which

passes alternately to sequence switch to ground and over tip of trunk to the sender, when the RD relay operates. The L relay will release when ringing current is taken off the trunk. At the operation of the RD relay a circuit was closed to operate the TK relay which locks to its own front contact to the sleeve of the trunk. At the opening of M spring at the interrupter the RD relay will release. The CO relay will operate, closing the trunk through to the jack, also lighting the trunk lamp.

Note: The pulses sent back to the sender take the place of pulses sent back for Final Brush Final Tens and Final Unit selections on a regular call, so that the sender can be released. The cams on the Sequence switch being cut to arrange for enough pulses to release sender before trunk lamp lights.

BLANK CHOICE TRUNK CIRCUIT CALL TO INTERCEPTING OPERATOR

The intercepting operator plugs into trunk operating SI relay (Trunk Circuit) and SLA relay cord circuit (MGA does not operate). Battery from the MGA relay, winding SIA relay, sleeve of cord and jack winding SI relay to ground. The operation of SI relay opens trunk lamp circuit and provides ground for the TK relay. The SA relay operates from battery through the SA relay, back contact MGA relay over the tip of the line to ground in the incoming selector circuit. The cord lamp burns from battery through lamp back contact FR relay, back contact of L relay, winding FS relay to ground at the interrupter. The intercepting operator throws listening key which operates the L relay. Cord lamp extinguished circuit changed to front contact of the L relay, winding TR relay to ground, TR relay operates. Operate the C

relay from battery through winding C relay back contact C-1 relay through interrupter, front contact TR relay, back contact CO relay, front contact I relay to ground at front contact of SLA relay. Interrupter out of circuit of C relay. Operate C-1 relay through front contact of C relay, over ~~same~~ path for C relay except interrupter. Operate TRP relay from battery ~~at~~ TRP relay, back contact of MGA relay, front contact of I relay, front contact of C-1 relay to ground at the back CO relay to ground. Operate CO relay, battery from CO relay, winding front contact C-1 relay. Interrupter contacts, front contacts TR relay, back contact CO relay, front contact I relay, front contact SLA relay to ground. CO relay locks up to its own front contact. Opening circuit of the C - C-1 relays operate FR relay, battery from FR relay. Listening key contacts, front contact of CO relay to ground, TRP relay released. Operation of FR changes circuit of cord lamp from battery through lamp, front contact SA relay, front contact FR relay winding FR relay to ground. Lamp is extinguished. Operate the T relay from battery at T relay, front of I relay, front contact FR relay to ground SLA relay. The operation of the T relay closes through the operator's set. The flash key operates the FL relay which holds relays operated during the flashing period.

SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- For what purpose are zero operator positions installed?
- 2- How will it be possible for the subscriber to call the zero operator?
- 3- How will three slot prepayment coin box lines be handled?
- 4- Describe the keyboard of zero operators' positions.
- 5- What is the Master Ringing Key used for?
- 6- How will reverting calls be handled?
- 7- What classes of trunks will terminate at Zero Positions?
- 8- What classes of trunks will terminate in subscriber's answering jack?
- 9- Describe the classes of outgoing trunks.
- 10- How are reports - for example, "~~My~~ Bell Rang" - handled by zero operator?
- 11- How are local numbers handled?
- 12- How are calls from manual subscriber lines handled?
- 13- How are calls for Chief Operator, Complaint Desk and other desks handled?
- 14- When necessary to call two stations and establishing a connection between them, how are they completed?
- 15- Tell the method for two number toll calls?
- 16- Calls from coin box lines for Ling Distance?
- 17- How are the calls supervised?
- 18- What supervision does zero operator receive on calls to manual offices via call indicator?

- 19- What supervision does the zero operator receive on calls completed to the office desks?
- 20- Describe the handling of a call for a number in her office.
- 21- What are the Intercepting positions used for?
- 22- Tell the kind of calls this operator handles.
- 23- Describe the keyboard equipment.
- 24- Describe the face equipment.
- 25- What has to be done if calls are to be intercepted?
- 26- How are vacant lines taken care of?
- 27- How many vacant lines can be connected to one trunk to an intercepting position?
- 28- How are calls to blank choices taken care of?
- 29- What method is followed in the case of:
 - (a) A Cut-off complaint
 - (b) Don't Answer.
- 30- What may be necessary at the time of the cut-over?
- 31- For what purpose is the voltmeter cord used?

PLANT SCHOOL

SEATTLE WASHINGTON

PANEL MACHINE EQUIPMENT

LESSON NO 12

SUBJECT

MISCELLANEOUS CIRCUITS

LESSON NO 12

MISCELLANEOUS CIRCUITS

HOLDING LINE FOR PERMANENT SIGNALS - SENDER MONITOR ES-226315

A permanent signal on a panel machine switching subscriber's line is caused by the line being short circuited or grounded on the ring side the same as in manual practice.

When the district selector is routed to the permanent signal holding trunk group the I relay operates. Battery, winding I relay, back contacts CO relay, through subscriber's loop (or to ground in case of ground line), back contact CO relay and winding of the I relay to ground. The lamp flashes when the I relay operates. Battery, 0.53 sec - 0.53 sec to interrupter, back contact MB relay, front contact I relay and #2 U lamp to ground. The auxiliary signal circuit is also energized. Ground, back contact MB relay, front contact I relay and auxiliary lead to battery.

On noting the flashing lamp the sender monitor plugs a talking cord into the answering jack, operating the CO relay. Battery, sleeve of plug and winding of CO relay to ground. The operation of the CO relay closes the talking lead from the jack through to the line and closes a circuit to operate the MB relay and hold the I relay. Battery, winding MB relay and front contact of CO relay to ground. Battery, and winding I relay to ground at front contact of CO relay holds I relay operated. The operation of the MB relay changes the flashing lamp signal to a permanent lamp signal. Battery, front contact

MB relay, front contact I relay and lamp to ground. The MB relay locks through the disconnect key to ground. The operation of the MB relay also makes the sleeve wire of the trunk test busy. Ground and front contact MB relay to sleeve lead.

The sender monitor then challenges on the line and at certain time intervals, places the howler plug in the jack. During the interval the howler plug is in the jack, the supervisory signals are transferred to the howler circuit. If after challenging and putting howler on the line, the trouble is not cleared, the line is placed on a plugging-up line connected at the M.D.F. protectors, which clears all other equipment as will later be described.

When the plug is removed from the jack the signals are again in use. With the MB relay operated and locked up, the I relay held up through subscriber's loop or other-wise, and the CO relay released due to the removal of the plug from the jack, if the trouble should clear out, the I relay would release. The release of the I relay would cause the permanent signal lamp to flicker. Battery, 0.2 - 0.2 interrupter, front contact MB relay, back contact I relay and lamp to ground. On noting this signal the sender monitor depresses the disconnect key (Disc), which opens the holding circuit of the MB relay when it releases and extinguishes the lamp. The district selector is released and the permanent signal holding trunk is available for use by another call.

If, however, the trouble is not cleared, after a period of time, the sender monitor will refer it to the repair clerk giving all information as to time, telephone number, plugging-up circuit number assigned and any other pertinent information.

The sender monitor then notifies the frame man and he places the line on a plugging-up circuit at the M.D.F.

As soon as the frame man removes the heat coils, the subscriber's line will be opened and the permanent signal holding trunk released, unless the trouble is in the office.

PLUGGING-UP LINE CIRCUIT - SENDER MONITOR DESK ES-207716

With the subscriber's line placed on a plugging up line circuit at the M.D.F. protectors, a circuit is closed to operate the BY relay. Battery and winding BY relay to ground at annunciator contact of the jack. Operation of the BY relay closes a circuit to light the green lamp. Battery, front contact BY relay and green lamp to ground. With a short or a ground on the line the I-1 relay operates. Battery, winding I-1 relay, line jack and ring side of line to ground, or shorted subscriber line through subscriber's loop back on tip of line to ground at line jack. While the line is showing busy, the Red lamp is lighted, battery front contact of BY relay, through red lamp through 24-B key, front contact of the I-1 relay to ground at the jack. For testing purposes, when a plug is placed in this jack, the battery and ground are cut off by the annunciator contacts of the jack and the test lead connected directly to the line. A 24-B key is arranged in the circuit so that the operation or non-operation of the I-1 relay may be noted by the red lamp. As this lamp may denote whether trouble is clear or not, the key changing the lamp lead to either the front contact of the I-1 relay or to the back contact.

The jack and lamp associated with the inside office equipment is for use in case a calling party is connected with the out-of-order line. Its method of operation is as follows:

When a final selector has seized the terminals of the out-of-service line, (the condition being the same as an idle line), the ringing power will be put in the circuit which will operate the I relay. Generator through the ring of the plug-up line annunciator contacts of the switchboard jack through a I-MF condenser, the winding of the I relay, back through the jack, the tip side of the line to the ground side of the generator lead. The I relay then locks up through its front contact the circuit of which is: Battery, auxiliary signal circuit front contact of BF relay, front contact of I relay and winding of the I relay to ground at the jack. The white lamp lights up. Battery, auxiliary signal circuit, front contact of BY relay and white lamp to ground. On receiving this signal the sender monitor plugs in the jack which opens the circuit of the I relay which in turn opens the circuit of the lamp and informs calling subscriber of the trouble condition of the called line. Removal of the shoe terminal clears the plugging-up line for another call.

HOWLER CIRCUIT

The Howler cord enables the sender monitor to connect a graduated howler tone to a subscriber's line for the purpose of attracting the subscriber's attention to the fact that his receiver is off the hook by means of rotary switches under control of the howler key, and can only be connected to the line at its minimum intensity.

CIRCUIT ES-226316

With the ROH on the subscriber's line and the howler circuit plug in the answering jack of the holding trunk, or the plugging up line, a circuit is closed to operate the SLV (sleeve) relay.

Battery, winding SLV relay, sleeve of plug and jack to ground at CO relay; or in case of a plugging-up line, to ground on sleeve of the jack through resistance. Also as long as the receiver is off the hook, the B-4 relay operates. Battery 8 - 7 repeating coil, winding of B-4 relay, ring of plug and jack, subscriber's loop, tip side line, tip of plug and jack, windings 3 - 4 of repeating coil to ground. Under this condition, if the subscriber should hang up, the release of the B-4 relay would light the lamp by a circuit from battery at back contact of the B-4 relay, front contact of SLV relay through the lamp to ground. From this the sender monitor would know that the trouble had cleared. If the lamp does not light the monitor depresses the howler key. This provides a circuit to operate the S-1 relay. Battery, front contact of B-4 relay, winding of S-1 relay to ground at closed contacts of the key. The operation of the S-1 relay flashes the supervisory lamp. Interrupted battery from interrupter (0.2 - 0.2) front contact of S-1 relay, back contact of SR-2 relay, front contact of SLV relay through the lamp to ground. It also closes a circuit to operate the CI relay, battery winding of CI relay, front contact of S-1 relay. Normal contacts of BB are to ground at the key. The CI relay locks up through its front contact to ground at the key.

The stepping magnet is then energized by a circuit from battery winding of STP magnet, front contact of S-1 relay, back contact of the SR-2 relay, the normal contacts of the S are to ground at the 0.3 - 0.2 second interrupter. This circuit advances the rotary switch out of the normal position to position 2. The operation of the CI relay closes the primary howler circuit. Battery through the 460 PPS

segment of the ringing machine, the front contact of the CI relay, back contact of the DT relay, back contact of the SR-2 relay through the primary coil 2- 1- through the 25A coil to ground. The advance of the switch to position 2 closes the circuit of the secondary howler. Ground from the key, 2- 1- 6- 5- winding of the repeating coil through the A-B winding of the secondary coil, the #2 contact of the AB arc to ground at the key. This is the first stage or minimum intensity of the howler and is induced into the subscriber's loop through the other winding of the repeating coil.

The switch advances through ten positions, each one of which increases the field of the secondary coil, consequently increasing the pitch and loudness of the howler tone. The circuit of the stepping magnet is as follows: Battery from winding of the STP magnet, through the bridged contacts of the S arc to ground on the 3- 2- second interrupter. This interrupter circuit makes 3 seconds and breaks 2 seconds and thus advances the switch on each closure.

On reaching position 12, which is open on the BB arc, the secondary circuit is opened for a period and again closed through the minimum AB secondary and again graduated to the highest pitch. If the receiver is still off the hook and the howler key is still depressed, the howler circuit will be opened and cannot again be connected to the line until the key has been released and depressed again.

When the switch has advanced to position 22, a circuit is closed to operate the SR relay (second revolution). Battery, winding of the SR relay, back contact of SR-1 relay to ground on SR arc. Operation of the SR relay closes a circuit to operate the SR-1 relay and hold the SR relay. Battery, winding of the SR relay, winding of

the SR-1 relay, front contact of the SR relay to ground at the key. The operation of the SR-1 relay closes a circuit to operate the SR-2 relay. Battery, winding of the SR-2 relay, front contact of the SR-1 relay to ground on SR arc. The SR-2 relay locks up through its front contact to ground at the key. The operation of the SR-2 relay opens the primary howler circuit. It also opens the flashing circuit of the lamp and opens the circuit through which the switch magnet is energized to move the switch out of normal. From this it will be seen that as long as the SR-2 relay is operated, the switch cannot be advanced and that the primary howler circuit is open. The SR-2 relay is locked up as long as the key is depressed.

If, at any time during the operation of the howler, the subscriber should hang up, the release of the B-4 relay would release the S-1 relay and light the lamp with a permanent signal. The release of the S-1 relay would close a circuit to operate the D.T. relay, battery winding of DT relay, front contact of CI relay, back contact of S-1 relay, front contact of CI relay to ground at the key. The operation of the DT relay opens up the primary howler circuit. If the key was not released the switch would return to normal by a circuit from battery winding of STP magnet, S arc to the interrupter. If the key was released at any time during the operation of the howler the switch would advance to normal by a circuit from battery winding of STP magnet, front contact of STP magnet, RN arc to ground at normal contact of key, as this circuit is self-interrupting as a buzzer the switch advances to normal when it is opened at the RN arc.

From the fact that the switch returns to normal after each operation it can be seen that the howler can only be placed on the

line at its lowest intensity.

MISCELLANEOUS CIRCUITS

Test Line to Trouble Desk From Local Test Desk ES-239410

A test line from the test desk to the trouble desk enables the testboard man to test any line that may be on the hospital cords, or tied up on the trouble desk.

With the plug of the test cord in the answering jack of the plugging-up line or any other line, a circuit is closed to operate the SLV relay. Battery through winding of SLV relay, through the sleeve of the plug to ground, on sleeve of the jack. The operation of the SLV relay closes a circuit through the auxiliary signal circuit and another circuit from the 2-3- interrupter, back contact of H relay, front contact of the SLV relay and the red lamp on the test desk to ground flashing this red lamp signifies to the tester that the line is placed on test. When the tester places a plug in the jack at the test desk, he furnishes battery from the sleeve of his cord through the CO relay to ground, which operates the CO relay and opens auxiliary circuit connected to the line by the CA Relay and leaves the tip and ring conductors closed through to the line. When the CO relay is operated a circuit is closed to operate the H relay, battery winding of H to ground at front contact of the CO relay. The operation of the H relay opens the flashing circuit of the red lamp and the auxiliary signal circuit signifying to the trouble operator that the tester has taken the line for testing. The H relay locks up to ground through its front contact to ground on the front contact of the SLV relay. When the tester is through testing and

wishes to have the trouble operator clear the line, he depresses the disconnect key, which operates the D relay. Battery, winding of D relay to ground at key. This closes a circuit through the disc lamp which lights up and signifies to the trouble operator to disconnect the cord

If, however, the tester should neglect to clear the line after removing his test cord, and the subscriber on the line should remove his receiver from the hook seeking to place a call, the CO relay being released, the I relay would operate, battery, winding of I relay, back contact of CO relay, through test cord and subscriber's loop and back to ground on the back contact of the CO relay. The operation of the I relay closes a circuit from the 2- 3- interrupter, front contact of the I relay, the white lamp to ground and flash the white lamp and also close a circuit through the auxiliary signal circuit calling attention to the fact that the cord has not been cleared.

Sender Monitor Cord Circuit - ES 226044

Talking cords are provided to enable the sender monitor to talk and supervise on subscriber's sender circuits and plugging-up circuits. Each circuit consists of a cord and plug (no connections are completed through the desk), a supervisory lamp, a talking key, a flashing key, a coin return and a coin collect key, and a coin pilot lamp. All of this equipment appears in the keyshelf except the pilot lamp (coin), which is in the face of the board. The circuit is arranged so that when answering on the intercepting side of the plugging-up circuit, no charge will be made either on calls from machine switching or manual offices.

When the sender monitor inserts the talking cord in any of the circuits to answer a call the supervisory lamp is extinguished if some one is on the line; otherwise it is lighted.

On placing the plug in any one of the trunks other than the intercepting side of the plugging-up line, a 1000^W resistance will be connected to the sleeve of the jack to ground. This is so as not to operate the M.G. relays (Marginal) in the cord circuit

The first relay to operate is the SLV relay, battery winding of SLV relay, one winding of the MG relay, sleeve of plug and jack through 1000^W resistance to ground. The operation of the SLV relay closes a circuit through the lamp, the front contact of the SLV relay, back contact of the S relay to ground in case the S relay is not operated (no one on the line). If a subscriber is on the line a circuit is closed to operate the S relay, battery winding of S relay, back contact of MG relay, 1- 6- 5-, winding of repeating coil, back contact of C.N. relay through plug and subscriber's loop, back on tip, back contact of CN relay, 2- 1-, winding of repeating coil to ground on the back contact of the MG-1 relay.

The sender monitor then operates the talking key, T, which operates the TP relay, battery winding of TP relay, back contact of CO relay, contact of key to ground on front contact of the S relay. The TP-1 relay then operates battery winding TP-1, back contact of TP-2, front contact of TP relay, through the 2- 2- interrupter to ground at the F relay. This closes a circuit to operate the TP-2 relay. Battery, winding of TP-1 relay, winding of TP-2 relay front contact of TP-1 relay to ground on front contact of TP relay, also

holding the TP-1 relay. The CN relay then has a closed circuit and it operates. Battery, winding of CN relay, front contact of SILV relay, back contact of CO relay, front contact of TP-1 relay, front contact of TP relay through 2- 2 interrupter to ground at back contact of F relay. The TF relay then operates. Battery, winding of TF relay, front contact of CN relay, to ground at front contact of TP 2 relay. The operation of the TF relay closes a circuit to operate the CO relay. Battery, winding TF relay, front contact of TF relay, back contact of CO relay, winding of CO relay to ground at front contact of SILV relay. The CN relay is of the slow releasing type so as to give time for the TF relay and CO relays to operate and lock. Locking circuit for TF relay, battery, winding TF relay, front contact of CO relay 500 Ω resistance to ground on T key. Locking circuit for CO relay, battery, front contact of CO relay, winding of CO relay to ground at front contact of SILV relay. The operation of the CN relay momentarily places a 300 Ω short across the cord circuit and opens the holding circuit of the S relay. Operation of the CO relay opens the operating circuit of the TP relay which releases, in turn opening the holding circuit of the TP-1 relay and TP 2 relay and they release. The release of the CN relay again closes the subscriber's loop around the S relay and it operates, furnishing battery and ground to the calling subscriber through the repeating coil. It will be understood from this arrangement, in answering uncompleted calls or stuck senders and miscellaneous circuit failures, that inasmuch as the district sequence switch will not have reached the talking selection position, the sender monitor will furnish talking battery to the

calling subscriber. The talking circuit of the sender monitor's set is connected through the talking key and the T relay in the sender monitor's telephone circuit.

The T relay in the sender monitor's telephone circuit operates on a circuit, battery winding of T relay, back contact of TP relay (SM), front contact of CO relay, T key to ground at front contact of S relay. The operation of the T relay closes the talking leads through to the induction coil.

If the sender monitor desires to flash back on the circuit to call attention of manual operator he will depress the non-locking flash key (F), which will close a circuit through the F relay. Battery winding of F relay to ground at key. This closes a circuit to operate the CN relay. Battery, winding of CN relay, front contact of TP relay to ground at front contact of the F relay. The CN relay being slow releasing after the key returns to normal and the F relay releases, there is a moment when a dead short is placed across the tip and ring of the cord. Circuit is from tip of cord front contact of CN relay through key back contact of MG relay, front contact of CN relay to the ring of the cord. This gives a short circuit every time the flash key is depressed and flashes the manual operator's supervisory lamp.

If the status of the call requires the sender monitor to refund the coin due to inability of the equipment to function properly or due to the line called being out of order, he will depress the coin release key which will operate the CN relay, battery winding of CN relay to ground at CR key. If there is a coin in the box, he will receive a lamp signal on the coin pilot by the following circuit:

Operate the CR relay 110 V - neg. winding of CR relay through the CR key, the front contact of the CN relay to the tip of the line. The coin pilot lights up from battery through auxiliary signal circuit through pilot lamp to ground at front contact of the CR relay. If, on the other hand, circumstances require the collection of the coin, he will depress the CC key, and the circuit progresses as in coin release except that the CC relay operates.

Another condition which will be met will be to answer calls for lines which are on plug-up circuits to notify calling subscriber of the condition. In this instance it will be unnecessary to furnish battery to the calling subscriber as the call would have been completed up to the ringing and talking stage but the circuit must be arranged so that the calling subscriber will not be charged for the call if service is measured or the coin will not be deposited as on a completed call. The method of operation under this condition is as follows:

Associate the cord circuit with the plug-up circuit. If a selector seizes the terminals of a line which is plugged up on a hospital cord, the call will proceed as though the line were idle and ringing will take place. This ringing will operate the I relay in the plug-up circuit. This relay will lock up and bring in a lamp as described before.

On answering this call, the sender monitor places the plug in the switchboard side of the plug-up line circuit. The sleeve of this jack having a dead ground, the MG relay will operate in series with the SIV relay which operates the same as for other calls. The operation of the MG relay closes a circuit through the MG-1 relay and

it operates. Battery, winding of MG-1 relay to ground at front contact of the MG relay.

Operation of the SIV relay closes a circuit through the lamp and lights same in case subscriber has abandoned call.

The S relay operates battery winding of S relay, front contact of MG-1 relay, one-half winding of repeating coil, back contact of CN relay, over the tip of the trunk, through the F cam in the incoming circuit to ground on the front contact of the R-2 relay. The operation of the S relay closes a circuit to operate the TP relay, battery winding of TP relay, back contact of CO relay, key T to ground at front contact of the S relay.

The TP-1 relay then operates, battery winding of TP-1 relay, back contact of TP-2 relay, through the 2- 2- interrupter to ground, at back contact of the F relay. The operation of the TP-1 relay closes a circuit to operate the TP-2 relay and hold the TP-1 relay. Battery winding of TP-1 relay, winding of TP-2 relay, front contact of TP-1 relay to ground at front contact of the TP relay.

The CN relay then operates battery winding of CN relay, front contact of SIV relay, back contact of CO relay, front contact of TP-2 relay, front contact of the TP relay, through the 2- 2- interrupter to ground at the back contact of the F relay. Operation of CN relay closes a circuit to operate the TF relay. Battery, winding of TF relay, front contact of CN relay to ground at front contact of the TP-2 relay. The operation of the TF relay closes a circuit to operate the CO relay. Battery, winding of TF relay, front contact of TF relay, back contact of CO relay, winding of CO relay to ground at

front contact of SIV relay. The CO relay locks up through its front contact. The operation of the CO relay opens the circuit of the TP relay and it releases in turn opening the locking circuit of the TP-1 and TP-2 relays and they release. The operation of the CN relay momentarily closes a 300 ohm short across the tip and ring of the cord circuit and trips the ringing relay in the incoming circuit.

The operation of the MG-1 relay puts battery on the tip of the trunk to the incoming selectors circuit and leaves the ring side open, therefore preventing the Incoming CS relay from operating, as the operation of this relay would have set up a circuit to operate the CS-1 relay (Incoming Selector) which would have reversed the polarity of the tip and ring leads to the district operator, the district CS relay and charging the subscriber for the call.

TELEPHONE CIRCUIT - DESK SWITCHMAN POSITION

Circuit #226560 shows the arrangement of the telephone circuit on the desk switchman's position, the circuit is arranged to be used with:

Test cords and lines other than trunk line to final frames and for these circuits it operates as follows:

By the operation of the keys of the talking trunks to the talking position and by the operations of the talking keys of the test cord circuits, the telephone circuit is connected to these circuits. A ringing key is also provided which enables the desk switchman to ring on those trunks which are on ring-down basis. A secondary cutout key (S.C.O.), is provided which cuts out the secondary winding of the induction coil, thereby enabling the switchman to listen on circuits

without interference from his transmitter.

If the loud speaking circuits are installed in Rainier, West and North offices from desk switchman's position to the switchman, the "X" and "Y" wiring shown on desk switchman's position telephone circuit will be used. Also if the transfer key transferring the circuits from the desk switchman's position to the sender monitor's telephone circuit is used, the wiring shown as "Z" leads will be used.

Dial Equipment of Desk Switchman's Telephone Associated
With Trunk to Final Frame ES-226314

A dial is associated with the desk switchman's telephone circuit which enables the desk switchman to make calls on the exchange talking trunks from the final frame, T-1, R-1 and S-1 on desk switchman's telephone circuit connect with T-1, R-1 and S-1 on circuit #226314 which is a two-way trunk from final frame and line finder to the desk switchman's position. The talking trunk to the final frame enables the outside force to reach the desk switchman by dialing the assigned number. The trunk should also be cross-connected to the Line Finder Frame, enabling the desk switchman to make outgoing calls. They should not be listed in the directory and should preferably be in the section of the final multiple reserved for official lines.

The operation of the circuit on incoming calls to the desk switchman is as follows:

When the number assigned on the final frame for calls to the desk switchman is found by the final frame selector, ringing current is sent out over ring of the trunk through I.M.F. condenser 450^W winding of G-18 relay, returns over tip of trunk to ground at final

frame. This operates the G-18 relay which locks up through its locking winding, and also closes circuit from the interrupter, which causes the trunk lamp to flicker.

The desk switchman then operates key (T) for talking, which closes T and R of trunk through to T-1 and R-1 of telephone circuit, the ringing current from final frame over R-1 through the pulse contact of dial, back contact of D relay, winding of TP relay, resistance of #54-A Retardation Coil to T-1 through contact of T key to ground at final frame, trips the ringing at final frame and in return sends battery and ground which operates TP relay; operation of TP relay operates TP-1 relay from battery, back contact of TP-2 relay to ground at dial. The operation of the TP-1 relay operates TP-2 relay from battery, winding TP-2 relay, front contacts of TP-1 relay to ground at dial. The operation of TP-2 relay opens the circuit of the TP-1 relay and at the same time locks up through its front contact to ground at the dial; the operation of the TP-2 relay also operates the T relay from ground at the dial, back contact of TP-1 relay now released, front contact of TP-2 relay, winding of T relay to battery, the operation of T relay closes T-1 and R-1 through to the secondary of desk switchman's telephone circuit.

The operation of T key for talking also closes the S-1 circuit through from telephone circuit to the trunk circuit for changing from flickering to permanent light. The circuit is from ground at the dial over S-1 through make contacts of T key, make contacts of H key, winding of B relay, winding of CO relay to battery, the operation of CO relay transfers the trunk light from the interrupted battery to

a permanent battery and the trunk lamp changes from a flickering light to a permanent light, the CO relay also opens the locking circuit of the G-18 relay.

If the desk switchman wishes to hold the trunk he operates the H key which opens the trunk from the telephone circuit and transfers it to the holding circuit, ground at the H key replaces ground from the dial when talking key was depressed, and holds the B relay and CO relay operated; the holding circuit is from the R of trunk, through made contact of B relay, 450^W winding of G-18 relay to T of trunk, thus placing 450^W loop across the trunk.

When the desk switchman disconnects from the trunk, the trunk light should be retired if the party calling has hung up. If the party remains on the line the S relay is operated by battery on the sleeve of the trunk at the final frame and ground from the closed contact of the S relay through the locking, winding of CO relay to battery holds the CO relay operated and the trunk lamp remains permanent signal until subscriber hangs up.

When the desk switchman wishes to call a subscriber he uses the dial in connection with the trunk to final frame. The T-R-S terminals of the trunk circuit are cross-connected to the line finder terminals T-R-S.

The method of operation is as follows:

The desk switchman operates the T key which connects the T and R of trunk to the T-1 and R-1 of desk switchman's telephone circuit. The T key also closes a circuit from ground at dial S-1 wire, made contact of T key, H key, winding of B relay, and 350^W winding

of CO relay to battery, which lights trunk lamp and the operation of B relay closes loop across T and R of trunk through 450^W winding of G-13 relay, this loop energizes the line relay of line finder circuit which starts a line finder circuit to find line originating the call. When the desk switchman receives the dial tone, he dials his number accordingly.

The operation of the dial (during the pulse period) operates the D relay from ground. At the dial the D relay is only operated during the pulsing period and the operation of the D relay closes the dial loop across the trunk through the pulse contact of the dial and as the dial is operated according to the number dialed, the pulse contact is opened and closed.

After the number has been dialed, battery and ground is sent back over the trunk from the district frame which operates the TP relay. The operation of the TP relay operates the TP-1 and TP-2 and T relays, as previously described in this lesson. The operation of the T relay closes T-1 and R-1 of trunk through to the secondary of the telephone circuit. When the desk switchman is through talking he releases the T key of trunk which disconnects dialing apparatus and telephone circuit from the trunk.

TALKING TRUNK TO LOCAL STATIONS

Two-way talking trunks - Circuit #226095 - are provided between local stations and the trouble desk, the desk switchman's position or sender monitor's position to enable desk switchman and other members of the maintenance force to have communication from different

parts of the building such as rackman's telephone, rest room, power room, etc.

A number of local stations can be connected to the same circuit, in which event each one is called by a code ring. For example, to ring the local station bell the desk switchman will operate the trunk key which will connect his telephone circuit with T and R of local station trunk; then by depressing ringing key associated with desk switchman's telephone circuit ES-226560 will send ringing current over ring of trunk through normal contacts of L relay, bell and condenser of Subset I-2 terminal, through normal contact of I relay to ground, which rings the bell.

When receiver is removed from switchhook, battery for subset is from 160^M winding of L relay, I-1 terminal subset, primary of induction coil, switchhook, transmitter I-2 terminal to ground at I relay, which operates I relay and closes T and R of trunk through to local station for talking.

When the T key of trunk was depressed it closed a local circuit from ground at the key through winding of CO relay to battery and the operation of CO relay lights the trunk lamp from battery through the made contacts of CO relay, and trunk lamp to ground, the trunk lamp remains lighted during conversation to local station; also if desk switchman releases T key the trunk lamp remains lighted as long as receiver is off hook at local station. When the local station calls the trouble desk the I relay is energized by the removal of receiver from switchhook, the I-1 relay is energized from ground at front contact of L relay through back contacts of CO relay, winding of I-1 relay to battery.

Operation of L-1 relay lights the trunk lamp by battery through interrupted front contact of L-1 relay, back contacts of CO relay through trunk lamp to ground which operates trunk lamp (flashing).

Desk switchman answers by depressing T key which connects his telephone circuit across trunk for talking, also operates CO relay by ground from contact of T key through winding of CO relay to battery.

Operation of CO relay changes the trunk lamp from flashing signal to permanent signal by battery through front contact of CO relay through trunk lamp to ground. The operation of CO relay also closes a locking circuit to lock the CO relay and hold trunk lamp lighted until receiver is replaced on switchhook at local station. The CO relay is locked up by battery through the winding of CO relay, front contact of CO relay to ground, through the front contact of L relay.

The disconnect is caused by both the desk switchman disconnecting from the trunk and the receiver replaced on switchhook at local station which releases the CO relay which act opens the trunk lamp circuit and it is extinguished. The trunk is then ready for another call.

VOLTMETER TEST CORD

General

In the first installations of Panel Offices at Seattle, the duties of the Sender Monitor, Desk Switchman and testing at the Out Trunk test board will be combined, and the Voltmeter Test Cord

Circuit #ES-207571, which terminates on two plugs. One will be located at the Sender Monitor's position and the other at the Desk Switchman's position.

Description of Equipment

The Voltmeter Test Cord enables the Desk Switchman to:

- (1) Determine the character and approximate location of short circuits, grounds and crosses.
- (2) Measure Insulation Resistances.
- (3) Measure capacity of cables and condensers.
- (4) To measure foreign potentials and currents.
- (5) Ring, and
- (6) Talk.

The equipment and circuit arrangements are very similar to those provided for the local test desk #12, and consists of: a 100 volt test battery having a 20 volt tap, a 120 volt 100,000 ohm voltmeter, also having a 20,000 ohm, 24 volt scale, a 1000 ohm, 24 volt scale and a 4 ohm 480 ampere scale; consists of three lamps, one a supervisory lamp with a white lamp cap, a second a busy lamp with a red lamp cap, and a third, a ground lamp with a green cap; also has two cords with plugs, one at the Sender Monitor's position and one at the desk switchman's position, and of the associated keys located in the keyshelf.

The cord at the sender monitor's position is for use with plugging-up circuits and subscriber's senders and that at the desk switchman's position for use with the inter-office trunks and trunks for Main Frame tests. If the cord at the Sender monitor's position

is used through mistake and is connected to a busy inter-office trunk, the tip and ring conductors will not be closed through as the SM relay in sender monitor cord circuit will be shunted by ground on sleeve of busy inter-office trunks.

METHOD OF OPERATION

If the desk switchman wishes to connect the voltmeter testing combination to the Selector Test Cord Circuit, he should operate the key marked "TEST". The selector test cord circuit is for testing R.C.I. trunks to manual offices and by use of the voltmeter test cord circuit, he can assist the inside man at the manual office in determining the nature of the trouble.

Should he wish to connect the voltmeter testing combination to the sender monitor's position, he should operate the sender monitor key (Sen. Mon.). Assuming that the desk switchman wishes to test an inter-office trunk, he should insert the plug of the voltmeter test cord of his position in the test jack of the inter-office trunk and at the same time operate the make busy key (M.B.) which will cause the tip and ring conductors of the test circuit to be closed through if the trunk is not busy. If the trunk is busy under these circumstances, the red lamp is lighted because of the CI relay not operating, due to sleeves of busy trunks being grounded. Should he wish to test a busy trunk, he can disregard the busy condition by operating the "No Test" key (N.O.T.), which will close tip and ring around the CI relay contacts. The desk switchman should only use this key, however, when he is certain the inter-office trunk is otherwise out of service or if there is a make busy plug in the make busy jack.

The operation of the make busy key also causes the green lamp to become lighted and to remain so as long as the make busy key is operated. The desk switchman should then make the necessary tests by the manipulation of the following keys:

Reverse key (REV)
Ground key (G)
Voltmeter Reverse Key (VM-REV)
Foreign Potential Key (F.EMF)
Ammeter Key (AM)
20,000 ohm Scale Key (20,000^W)
1,000 ohm Scale Key (1,000^W)

according to the conditions of which he is testing for.

If the desk switchman wishes to talk he should operate the key marked (T-VM) which causes his telephone set to be associated with the test circuit and at the same time closes through the supervisory relays controlling the white lamp cap. When the desk switchman talks through the cord at his position or through the selector test cord, the supervisory circuit is arranged to be operated by battery and ground supplied at the distant end. For example, from the incoming selector, when the deskman talks over the cord at the sender monitor's position, as on subscriber's lines connected to plugging up circuits, battery and ground are supplied to the circuit in the standard manner through a #25-A repeating coil for furnishing talking battery and for energizing the supervisory relay. In either case when the white lamp is lighted it indicates that the circuit is open and when the lamp is out it indicates that the circuit is closed.

If the desk switchman wishes to ring a subscriber on a plugging up circuit he should operate the ringing key (RING).

If the test shows that the trunk is in trouble, it should be removed from service by inserting a make busy plug in the make busy jack. This plug does not have to be removed to make tests either with the selector test cord or the voltmeter test cord.

PLANT SCHOOL

SEATTLE WASHINGTON

PANEL MACHINE EQUIPMENT

LESSON NO 13

SUBJECT

FLOOR ALARM BOARD

LESSON NO. 13

FLOOR ALARM BOARD

GENERAL

The equipment on the floor alarm board provides an audible and visual means for attracting the attention of the floor switchman to the fact that certain parts of the machine switching equipment on the floor (other than power equipment) have become inoperative. The floor switchman should understand that these alarms may come in when the apparatus is in its normal position as well as its off normal position, and that the same trouble may bring in other alarms and especially after the lapse of approximately one minute indication of the sender lamps at the trouble desk. Alarms should be attended to promptly in order to maintain the best service and to avoid duplicate reports of trouble.

DESCRIPTION OF EQUIPMENT

The floor alarm board consists of one or more bays of iron framework on which are mounted the alarm pilot lamps and bells, and their associated equipment. The floor alarm board is usually located near the switchman's stand and centrally with respect to the location of the apparatus in the switchroom. On the floor where the trouble desk is located a floor alarm board may not be provided since the equipment may be located in the trouble desk.

(1) Alarm pilot lamps are provided which indicate when the fuses are blown on the following:

A Key (Motor Stop Alarm Only Locking)
An A. C. Ringer (Common to Groups 1 and
2 above)
A. D. C. Gong (Group 3 above)

METHOD OF OPERATION

On the sounding of either the A. C. ringer or D.C. gong, the floor switchman should at once take action to clear the trouble or abnormal condition as described under "Method of Handling Trouble", and as soon as this has been done, he should report the cause by telephone to the desk switchman giving such facts as the nature of the trouble or abnormal condition, the cause thereof, if found, and the action taken. This information will be entered by the desk switchman in the log book kept for that purpose. Unless the floor switchman notices the lighting of any of the aisle pilot lamps associated with certain fuse alarms and selector time alarm circuits or has received specific instructions from the desk switchman, he should go at once in response to the sounding of the alarm bells, first to the floor alarm board and, from the designation strip associated with the lighted alarm pilot, ascertain the location of the particular equipment in trouble. (See sketch #1). In connection with the stopping of a drive motor he should understand that the key associated with the lighted red lamp should be operated. This act will cause the red lamp to become extinguished and the associated white lamp to become lighted. As soon as he has the motor again running, the red lamp and the white lamp will be lighted. He should then return to the floor alarm board and restore the key which act will extinguish

both the red and white lamps. On all other alarm circuits as soon as the trouble or abnormal condition is removed the lamp is extinguished.

TELL TALE ALARM

The tell tale alarm is operated whenever a selector is driven to the top of the bank and its commutator brushes make contact with the X segment of the commutator. This segment establishes a circuit for a time alarm. The alarm sounds at the floor board and main alarm board or trouble desk.

METHOD OF OPERATION (See sketch #2)

Ground, segment X, through the P.S. relay (one winding) R O T sw. arc and P U to battery operates the P S relay which locks through its front contact. Ground from the front contact P.S. relay, back contact S relay and STP relay to battery, operates S T P relay. When time measure interrupter makes contact, the ground from interrupter also operates the S T P relay of the rotary switches which step one terminal each time the interrupter breaks its contact. P U and O N are stepped one point. This operation is completed three times and the P U and O N switches move to terminal #4, at which time a circuit is established from the P U switch to operate the S relay which operates and locks. Its operation opens the circuit of the STP relay to the interrupter and its armature falls back, closing a circuit from the interrupter again through the O N switch and STP relay, which steps switches to terminal #5 for another time alarm. At the operation of the S relay ground was closed through its armature contacts and the A relay to battery which operated it, in turn lighting

the lamps and sounding the alarm. If the trouble is cleared before the time measured off to give alarm, the stepping of the P U and O N switches off of the normal point gives the O N switch the control to send them to another normal point by its bridging brushes from #2 to #4, #5 being normal on the O N arc. The P U is closed on #5 terminal so in case of another tell tale alarm it can function.

LINE FINDER TIME ALARM - METHOD OF OPERATION (See sketch #3)

When B A relay in trip circuit operates, a circuit is established from the interrupter in the time alarm circuit.

Ground at interrupter "A- Start arc -#1 B lead B. 'BA.

"BA. Batt.

Thus operating relay B in the time alarm circuit.

Operation of relay B closes circuit through relay A.

Ground 'B. A start arc.#1 B lead. 'BA - BA Batt.

Operate STP relay. Time Alarm Circuit.

Ground Interrupter 'A STP Arc. STP. Batt.

Ground circuit at interrupter is closed one second and opened six seconds.

When ground at interrupter is open STP relay releases, the switch advances one step and will continue to advance one step at a time until the sixth point is reached, where the circuit is open.

A circuit is then closed to operate the B-9 relay.

Battery 'A through terminal 6 of lamp switch A lead 'BA BA lamp.

C lead B-9 Ground.

Operation of B-9 relay closes a circuit to operate A relay

common to aisle.

Ground 'B - 9. *A- Batt.

Operation of A relay closes circuit through signal alarm and lamp circuit - common to all frames.

If at any time previous to reaching the sixth point of the switch, the line finder is selected, the STPG magnet will step on to the sixth point on a circuit Ground "B- through bridging contacts of return arc through *STPG to battery at the sixth point this circuit is open.

ALARM SIGNAL TO SENDER MONITOR (Assuming Receiver Off Hook But Subscriber Does Not Dial).

Subscriber does not dial the circuit through to the sender is all set up and O N relay in the sender control circuit is operated. (See sketch #4).

Operate the M S relay, battery from or through winding of M S relay, back contact of M S relay closed point of M-2 arc. to ground at front contact of O N relay, the M S relay locks to its own front contact to ground at O N relay. Operate the M-STP relay, battery from STP 3-12 interrupter closed point of M-4 arc front contact of M S relay, back contact of TMA relay to ground at MSL relay (its back contact). M-4 switch moves to position or point #3 at this point the sender lamp burns brightly, the circuit is from battery at the lamp closed point of M-4 arc, front contact of M S relay, back contact of TMA relay to back contact of MSL to ground. Sender Monitor operator plugs in the jack associated with this sender lamp. In doing

this, he extinguishes the lamp and connects his set across the tip and ring of subscriber's line and challenges on line.

VOLTAGE ALARM (See sketch #5)

A Weston Model #30 Voltmeter relay is provided for this alarm circuit. When the battery voltage lowers below the proper point, this voltmeter relay is operated and makes a contact to operate the low voltage relay. Battery, 1200 ohms resistance, low voltage contact of voltmeter relay and winding of L relay to ground. Low voltage lamp lights and pilot relay (H.L.) operates. Battery, A C relay which operates through lamp, front contact L relay and winding H L relay to ground. Pilot lamp also lights from ground at front contact of H L relay through lamp to A C relay.

PHASE FAILURE (See sketch #6)

In case of phase failure, the phase failure relay operates. The P F relay releases and operates the P H A relay from battery through the D C relay lamp, closed contact of failure key, back contact of P H relay, and winding P H A relay to ground. The operation of P H A relay closes a circuit to light the pilot light through D C relay. The D C relay operates and sounds the alarm. It will be noted that in this case as well as for the ringing machines, the alarm circuit operations are performed through the release of certain relays which are held operated while these machines are running but when they stop, the alarm circuit functions. The key in the sketch is operated by switchman to cut-off alarm and the white lamp lights showing failure of that motor.

SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- What two alarms are provided on the floor alarm board?
- 2- Name the circuits having alarm pilot lamps on this board.
- 3- Under what condition does this apparatus function?
- 4- What is the purpose of the keys associated with the pilot lamps?
- 5- What is the tell tale alarm?
- 6- If the ground connection to the X commutator was open what would result?
- 7- What is the purpose of the B.A. relay in the line finder time alarm?

PLANT SCHOOL

SEATTLE WASHINGTON

PANEL MACHINE EQUIPMENT

LESSON NO. 14

SUBJECT

MAKE BUSY FRAME

LESSON NO. 14

CALL INDICATOR MAKE BUSY

For offices having more than one call indicator position provision is made so that any group of trunks to the call indicator position can be made busy so as not to be selected for incoming calls. The Make Busy equipment necessary is individual to each group of trunks and is located in the panel office. When a position is to be made busy the groups of call indicator trunks terminating in that position are made busy, the M.B. number and group number called.

The method of making groups of trunks terminating at a call indicator position busy requires special terminals on the final frames at the machine switching offices. Each machine switching office must have one "Master Make Busy" terminal and one "Master Make Idle" terminal for each manual office to which it has call indicator trunks, and one "Group Number" terminal for each call indicator position that has trunks from this office. To make a group of trunks busy, the Make Busy number and the group number are called. When the final selectors select these terminals, circuits are established to operate the M.B. relays which closes a circuit through the drive magnet of the make busy sequence switch causing it to move into the make busy position. In this position the sleeves of all the trunks are grounded and a distinctive tone is sent to the operator calling the Master Make Busy and Group Numbers over the trunk. This tone indicates the trunks to that position are made busy. Upon hearing

the tone, the operator takes down the connection and the final selectors release. To restore the trunks to service, the Make Idle and Group Numbers are called and when the final selectors select these terminals the Make Idle relay and the Group Number relays operate to close the circuit and revolve the sequence switch out of the Make Busy position to the Make Idle position. Another distinctive tone is sent to the operator calling the Make Idle and Group Numbers which indicates the trunks to that position are restored to normal and the grounds are taken off the sleeves. The call indicator trunks are then ready for service and the operator releases the final selectors.

METHOD OF OPERATION BY SUPERVISOR

When a supervisor desires to put a position out of service she will plug in an idle position at the "A" switchboard and select a trunk to the machine switching office and will then call a certain Master Make Busy number. While holding the connection to that number, she will select a second trunk to the machine switching office and call another number specified as the number to be dialed to make that particular group of trunks busy. She then will disconnect both cords and the trunks in that group will test busy.

To make the trunks idle again, the supervisor will repeat the operation performed to make the trunks busy, except that she will dial a different number specified as the Master Make Idle number in place of the Master Make Busy number.

The maintenance force in the machine switching office has no action to take in connection with the above operation, except to

see that sequence switch functions properly and that trouble is cleared promptly.

A Make Busy frame, when fully equipped, has thirty sequence switches each. which means one frame serves thirty groups of trunks, one sequence switch for each group of trunks. One sequence switch may be wired to make a group of sixty trunks busy.

SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- Why is it necessary to use Make Busy circuits?
- 2- How does the supervisor make all the relay call indicator trunks in a position busy when trunks from three machine switching offices terminate in that position?

PLANT SCHOOL

SEATTLE WASHINGTON

PANEL MACHINE EQUIPMENT

LESSON NO 16

SUBJECT

CABLING AND LOCAL WIRING

LESSON NO. 16

CABLING AND LOCAL WIRING

GENERAL DESCRIPTION OF CABLING PLAN TO VARIOUS RACKS IN FULL MECHANICAL OFFICE (SEE SKETCH #1)

The underground cables terminate on protectors on the vertical side of main frame and are cross-connected to the horizontal side of main frame. Cables are run to the horizontal side of I.D.F.; from this point, cables are run to the final frame carrying a multiple of each line, also cables are run from horizontal side of I.D.F. to the Message register rack.

The circuits are then cross-connected to the vertical side of I.D.F. and from here cables are run to the terminal strips of the line finder frames. Local wiring carries the circuits from the line finder's terminals to the line finder multiple brushes, line and cut-off relay etc. Local wiring also carries the circuits from the line finder commutators to the terminals of line finder again. From the line finder terminals cables carry the circuits to the district terminal strips and from here local wiring carries the circuits to the district selectors.

At the district other calls are run from terminal strips to the sender selector frame. These cables carry circuits connecting the sender circuits with the district; also cables are run from the

district frame to the repeating coil rack, connecting repeating coils and condenses with the district. From the district frame multiple, terminal strips cables carry the circuits to terminal strips on the horizontal side of the main frame where cross-connections are made to U.G. cables on vertical side of main frame for trunks going to a distant office.

For local trunks from the district frame cables are run from multiple terminal strips to vertical side of I.D.F. and there multipled to terminal strips on H side of main frame and here cables again carry the local trunk circuits to the incoming frame or inter-office incoming terminal strips and from this point local wiring carries the circuits to the incoming selectors.

From the multiple terminal strip at the incoming frame, cables carry the circuits to the terminal strips at the final frame; from this point the local wiring carry the circuits to the final selectors.

From the incoming frame cables are run to the repeating coil rack for connecting repeating coils and condenses with the incoming selector circuits. From the multiple terminal strips at the final frames, cables carry the circuits of the tip, ring and sleeve of each line back to the horizontal side of I.D.F. for incoming service from other offices.

If an office frame is used, cables are run from vertical side of I.D.F. to terminal strip at office frame; from here local wiring carries the circuits to the office frame selectors. From the of-

finder frame multiple terminal cables are run to horizontal side of Main frame.

In panel offices where cordless "B" board is used, cables will run from horizontal side of main frame to special repeating coil racks, then from there to special incoming frame for cordless "B" board circuits terminating at selector circuits of incoming frame, and from the multiple terminal strips of cordless incoming frame cables will carry the circuits to the final frame selectors.

Cables are also run from cordless incoming selectors to cordless "B" board trunk circuits at the "B" board, and from cordless "B" board recording keys to selectors on the finder frame.

From the multiple terminal of the finder frame, cables are run to the B sender circuits used for cordless "B" board service.

MULTIPLE SPLIT AND SLIPPING ON THE DIFFERENT FRAMES

In order to increase the efficiency of the trunks and cut down the average hunting time, the trunks in a group or sub-group on the line finder district office, and incoming frame multiple banks, are not multiplied straight through the frame; that is, the trunks in a group or sub-group do not appear in the same numerical order on all the frames to which they are multiplied but what is known as a split or slipping method of multiple is used.

SPLITTING AND SLIPPING OF MULTIPLE ON LINE FINDER FRAMES

Each line finder has access to fifteen banks of terminals and each bank contains twenty terminals, which is total capacity of three hundred terminals for the frame. (See sketch #2, Fig.#1).

Each bank of the twenty terminals is cut or split in the middle and the terminals reversed in the two halves, No.1 terminal in the first half being No.20 in the second half. This slipping is made on each of the fifteen banks of the line finder frame, the multiple wiring connection between the two halves is made by local wiring at a point where the multiple is split. With this arrangement, three hundred lines are multiplied before sixty selectors. (Sketch #2, Fig.#2). This shows how the multiple of two line finder frames can be arranged by slipping and splitting and serve nine hundred subscriber's lines. The multiple banks are split on a vertical line so located that forty line finders are on one side of the split and twenty line finders on the other side of the split.

This arrangement applies to both frames and the multiple is reversed between the two frames as shown in Figure #2. In this ar-

angement, each three hundred lines are multiplied before forty line finders.

Sketch #2, Fig. #3 shows the arrangement of the multiple split in the center of the frame, and then the multiple in each of half slipped. In this arrangement a line finder can care for six hundred subscriber's lines, each three hundred lines multiplied before twenty-eight line finders.

Where an extra split is required on a line finder frame there is a loss of four selectors, two on each side of frame because of the space required for local wiring to transpose the multiple of the two halves in each bank.

MULTIPLE OR TRUNK SLIPPING AT DISTRICT OR OFFICE FRAMES

The trunks at the district and office frames are slipped in layers of ten and in addition the order of count is reversed at each succeeding district or office frame multiple, for example, a sub-group of trunks would number 0 to 9 at the first district or office frame, and would be the bottom sub-group, and at the next multiplied district or office frame would be the top sub-group of trunks, and would number 9 to 0. (See sketch #3).

INCOMING FRAME - TRUNK MULTIPLE SLIPPING

On the incoming frame the slip arrangement of multiple used is similar to that at the district frame except that the number of trunks in a sub-group is six instead of ten trunks.

A group of trunks at the incoming frame is twenty-four and when slipping is applied each group is divided into four layers of six trunks each, and the order of count is reversed at each succeeding

frame, for example, trunks would number 0 to 5 from bottom up at the first incoming frame and at the second incoming frame this group of trunks would be transposed to the top layer and would number 5 to 0 from bottom up. (See sketch #4)

SPLITTING OF INCOMING TRUNK GROUPS

If twenty-four trunks is not sufficient to care for traffic to their respective final frame the multiple of a group of trunks can be split and twenty four trunks can be wired from each half of the split group to the final frame and thus add forty-eight trunks to the final frame.

FINAL FRAME

At the final frame each multiple terminal represents a particular line, therefore the slipping of multiple is not used, but the final frames are multiplied as many times as is necessary for traffic requirements to furnish additional selectors at the final frame. The multiple of the final frames can be split if traffic requirements to a final frame is low enough, and the multiple of one final frame would then serve in place of two final frames.

SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- What is the purpose of using the slipping and split multiple methods?
- 2- Describe the split and slipping method applied to a line finder frame of three hundred lines multiplied before sixty selectors.
- 3- Describe the split and slipping method applied to two line finder frames caring for nine hundred subscriber's lines.
- 4- Describe the split and slipping method applied on one line finder frame caring for six hundred subscriber's lines.
- 5- Describe the trunk group slipping method applied at the district or office frames.
- 6- Describe the trunk multiple slipping method applied at the incoming frames.
- 7- Describe the trunk multiple splitting method applied at the incoming frames;
- 8- Why is the multiple slipping method not applied at the final frame?
- 9- Describe how the multiple splitting method can be applied to the final frames.

SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- Which side of the main frame do the underground cables terminate on?
- 2- Which side of I.D.F. do the cables to line finders terminate on?
- 3- Which side of I.D.F. do the message register and multiple checking cables terminate on?
- 4- Name the different cables that associate circuits with the district frame.
- 5- Which side of I.D.F. do the outgoing cables from the district terminate on?
- 6- Which side of main frame do Incoming and Interoffice Incoming frame cables terminate on?
- 7- Describe the cabling arrangement where cordless "B" board is used.
- 8- Where do the cables terminate that are outgoing from Incoming and inter-office incoming frames?
- 9- Where do the cables terminate that are outgoing from the final frame multiple?
- 10- If an office frame is used, how is it cabled to the racks?

PLANT SCHOOL

SEATTLE, WASHINGTON

PANEL MACHINE EQUIPMENT

LESSON NO 17

SUBJECT

- (a) - LUBRICATION
- (b) - POWER PLANT

LESSON NO. 17

- (a) - LUBRICATION
- (b) - POWER PLANT

LUBRICATION

POWER DRIVE APPARATUS

	<u>Frequency</u>
Drive Motors	No conclusion yet reached.
Gear Boxes	Clean and oil every six months.
Bearings	None required under ordinary conditions.

OTHER APPARATUS

Sequence Switches	Annually
Interrupters	Monthly with vaseline
Translators	Same as for Sequence Switch
Other Rotary Switches	Same as for Sequence Switch

POWER PLANT

Service

Two sets of friction rolls are provided at each selector frame, one for driving the thirty brush support rods on one side of the multiple banks and one for driving the brush support rods on the opposite side.

The friction rolls are driven by gears from small motors. One motor is provided for each selector frame but in order to avoid putting a selector frame completely out of service in case a motor

steps, one motor is arranged to drive the friction rolls on the same side of two adjacent frames.

Duplex drive motors having two elements, one operating from a single phase alternating current circuit and one element operating from a forty-eight (48) volt direct current circuit are used. The motors are started from the direct current end and when up to speed, are connected to operate from the alternating current end. Upon failure of the alternating current supply, the brushes on the forty-eight Volt end are released by a magnet inside the motor frame and the motor operates on direct current until the alternating current is re-connected.

Connections

Each motor is provided with two sets of flexible leads each terminating in a plug. These plugs are connected to receptacles mounted in a box near the floor. The box contains two receptacles, two snap switches and two sets of fuses, a steel partition separating the A.C. line equipment from the D.C. line equipment.

The D.C. plugs and receptacles are arranged for three wires, the third wire being used for an indicating circuit to show that the motor is running on the forty-eight volt central office battery.

Signals

There will be one indicator lamp for each line of frames in addition to the pilot lamps. In order to determine which motor is running on the forty-eight volt battery in case only one line of frames is affected, the switchman can, by observing, determine the motor on which the D.C. brushes are in use or he can open the A.C. switch and

listen for the D.C. brushes to engage the commutator.

Starting

In starting a motor the D.C. switch should be operated first and when the motor has attained sufficient speed the A.C. switch should be operated.

Routine Inspections

The automatic drive motor control should be tested by operating the snap switches and observing that the power is continuous.

This test is made monthly.

Batteries

Under the present manual practice, storage batteries are charged until a certain specific gravity is obtained, the charge being discontinued when that certain specific gravity reading is reached. The battery is then allowed to discharge to a certain point. The batteries in panel machine switching offices will be charged and floated according to the load, from mercury arc rectifiers, these rectifiers being connected or disconnected according to the load. Forty-eight volt battery is used for signaling purposes while twenty-four volt battery is used for supplying talking battery.

SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- How often are Gear Boxes cleaned and oil changed?
- 2- What action is taken about "Bearings"?
- 3- How often are Sequence Switches oiled and cleaned?
- 4- How often are Interrupters cleaned?
- 5- How often are Rotary Switches cleaned?
- 6- What are the unit drive motors?
- 7- What kind of motors are used?
- 8- What takes place if A.C. power is off?
- 9- How many sets of leads for each motor?
- 10- What does the box near floor contain?
- 11- How is box arranged?
- 12- How many indicator lamps are used for one line of frames?
- 13- How can the switchman determine the motor effected?
- 14- Describe how a motor is started?
- 15- How should the automatic control be tested?
- 16- How often should this test be made?
- 17- How are batteries charged and floated in Machine Switching offices?

PLANT SCHOOL

SEATTLE, WASHINGTON

PANEL MACHINE EQUIPMENT

LESSON NO. 18

SUBJECT

CLEANING

LESSON NO. 18

CLEANING

COMMUTATOR SANDING

Preliminary to the general cleaning of a frame, the selector and finder commutators shall be sanded with #00 sand paper. In order to avoid scratching the commutators, the sanded sides of two pieces of paper should first be rubbed together to remove the sharp cutting edges of the particles of sand.

The sand paper should, for convenience in handling, be firmly secured to a wooden paddle or sanding block.

A fibre guard shall be inserted between adjacent commutators to protect the brushes from being struck by the sanding block. Care should be taken to exert a uniform pressure throughout the length of the commutator. The sanding will continue until the oxide on the surface of the segment and feeder strips formed in the insulating material have been removed. It is essential that as little of the metal as possible be removed from the commutator.

After the sanding of the commutators of a frame has been completed the commutators shall be rubbed with chamois or sheep skin to remove any particles tending to cling to the surface of the segments or insulating material.

CLEANING APPARATUS WITH COMPRESSED AIR

When all the commutators of a frame have been sanded and cleaned, the associated apparatus shall be cleaned with the vacuum

cleaner.

Place Vacuum cleaner in such a position that the hose can be carried up and down the ladder without fouling elevators, clutches, etc.

Place hose on blower nozzle and arrange it so that the stream of air is directed away from adjacent frames or other apparatus. Close all windows near the frame to be cleaned and see that no draughts exist by means of which a circulation of the air in the vicinity of the frame is permitted.

Clean all of the apparatus on one side of a frame before beginning on the other side. Before attempting to clean, make all circuits involved busy, and in the case of operators district frames, have the Traffic Department stop using the selectors.

MULTIPLE BANKS

With a 1-1/2 inch brush, clean the terminals of the multiple banks downward and between the elevators.

Hold the cup shaped nozzle attached to vacuum hose, opening up, just clearing the elevators and below the brush so that as much of the dirt released by the brush as possible will be caught by the nozzle. It is not necessary to brush directly into the tube, as any motion of the brush which will loosen the dirt without projecting it directly away from the nozzle will result in all of the dirt being caught in the current of air caused by the vacuum.

Raise all selectors to permit removal of dirt from reset and bearing plates under brushes.

BEARING PLATES AND DRIVE PLATES

With the soft rubber nozzle attached to vacuum hose, begin at the top of the frame to remove all pockets of dirt from the flat surfaces on the top and bottom commutator plates and on such set of elevator rods bearing plates.

Next, with the same tool, begin at the top of the sequence switch bay to clean any loose dirt and rust from the drive plates and pole pieces of the sequence switches.

IRON WORK AND WIRING

Replace soft rubber nozzle with cup shaped nozzle on vacuum hose and brush all iron work and wiring accessible from front of frame, beginning at the top of frame and working downward.

When brushing cable forms always brush the skinner toward the soldered connection.

Do not open counting relay cabinets to clean relays or framework. This apparatus shall not be touched.

Beginning at the top of the relay bay, clean the tops of the relay bays and shells of covered relays with a piece of sheep-skin slightly moistened with some approved oil, wrapped about the cleaning stick.

After the relay covers have been cleaned pass the vacuum hose through to the opposite side of the frame and with the soft rubber nozzle attached begin at the top of the sequence switch bay to remove the dirt from the sequence switch spring pile-ups.

Replace the soft rubber nozzle with the cup shaped nozzle and begin at the top of the frame to brush all the iron work and cable forms and skimmers of the switches and relays using the 1-1/2 inch brush. Special care shall be exercised while cleaning forms not to brush in such a manner that the skimmers will be broken or the insulation disturbed.

The preceeding operations should have removed all dirt possible to remove by brush or vacuum.

SEQUENCE SWITCH PILE-UPS

Change vacuum hose to blower outlet and attach the soft rubber nozzle at the apparatus side beginning at the top, blow through the sequence switch pile-ups.

SELECTOR RODS

Clean each rod with a piece of sheepskin slightly moistened with some approved oil.

SEQUENCE SWITCH CAMS

Sequence switch cams shall be cleaned by the application of a piece of sheepskin in the forked cleaning stick known as #239 tool.

The switch may be rotated by short-circuiting the "A" springs with the device provided for the purpose, known as the #218 tool.

In general, sequence switches shall be cleaned with the position or apparatus out of service. In all cases where the switch in rotating furnishes a momentary circuit to other apparatus the ground or battery condition shall be temporarily removed from the switch being cleaned.

At the same time that the sequence switch cams are cleaned the dust shall be removed from the separators between the cams and also from the blank cams.

ROUTINE TESTS SUBSEQUENT TO CLEANING OF APPARATUS

When all the apparatus associated with a side of the frame has been cleaned, tests for proper circuit operations shall be made before the apparatus is restored to service.

When one side of a frame has been cleaned and replaced in service, clean the other side before proceeding to another frame.

APPARATUS IN OPERATING AND TERMINAL ROOMS

The foregoing comprises the general cleaning of machine switching apparatus. The cleaning of key traps, cord pits, tarpaulins, fans, material lockers, etc. in the operating room, and furniture, relay racks, etc. in the switchroom, occurring at frequent intervals shall be assigned in the form of a schedule by the wire chief to the cleaner.

No floor preparation shall be used containing a substance which gives off oily or other fumes liable to cause corrosion or insulating deposits on contacting apparatus.

The floor of the switchroom shall be cleaned with a mop. No sweeping or brushing of the floor should be permitted except just after it has been mopped and is still in a damp condition.

All dusting in the switchroom should be done with cloth or sheepskin slightly moistened with some approved oil.

SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- What grade sand paper is used for cleaning commutators?
- 2- What precaution is taken to avoid scratching the commutator?
- 3- What device is used to protect the brushes?
- 4- To what is the sand paper attached?
- 5- To what extent shall the surface of the commutator be sanded?
- 6- What process completes the sanding of a commutator?
- 7- What precautions should be taken when cleaning the apparatus with the vacuum cleaner hose coming into contact with the apparatus?
- 8- How should the blower nozzle be held?
- 9- What is the procedure to be followed in the care of operator's district frames?
- 10- How are multiple banks cleaned?
- 11- How are Bearing Plates and Drive Plates cleaned?
- 12- Should counting relays cabinets be cleaned?
- 13- How are relays cleaned? Selector Rods? Sequence Switch Cams?
- 14- What should be done after an apparatus frame has been cleaned?

PLANT SCHOOL

SEATTLE WASHINGTON

PANEL MACHINE EQUIPMENT

LESSON NO. 19

SUBJECT

ROUTINE TESTS

LESSON NO. 19

ROUTINE TESTS

The following are the principal items of Panel switching equipment to be furnished for the initial installation at Seattle which require testing equipment:

- 1- Line Finders
- 2- District Selectors
- 3- Incoming Selector - Cordless
" Full Mechanical
- 4- Final Selectors
- 5- Subscriber's Senders
- 6- Cordless "B" Senders
- 7- A Sections.

DESCRIPTION OF ROUTINE TESTING EQUIPMENT

The following gives a brief description of each set or circuit of the various sorts to be supplied for Seattle offices:

Patching Cord Test Set

This is a set to be mounted on a side wall or frame and is used in testing the continuity of patching cords of all kinds.

Switchboard Cord Test Circuit

This is a circuit used in testing supervisory relay, and the continuity of cords in "A" switchboard.

Relay Adjusting Test Set

The relay adjusting set is designed for use in adjusting relays and other apparatus for which current adjustments are specified. It contains a millimeter and variable resistance for adjusting current values.

Selector Test Set

This is a set mounted on a tea wagon, for testing individual district, office, full mechanical, incoming or final selectors. It is used at the selector frames and is attached to a selector to be tested by patching cords placed in the test jack of the selector. The principal use of this set will be for adjusting apparatus found in trouble by the automatic tests and for testing the selector brushes which are not tested by the automatic routine test equipments.

Cordless "B" Incoming Selector Test Set

Jacks are supplied at the Cordless "B" selector frames where this test set is attached. The test set has a cord and plug representing the "A" operator's cord. The tester can order the trunk to be connected by the cordless "B" operator to the lines used for testing incoming selectors and thus obtain a test of the selector and of the ringing and supervisory relays. For adjusting the supervisory relay, the tester can order the trunk up on a line appearing before him on the incoming frame jack box and there attach the relay adjusting box.

Note: Routine tests of cordless trunks will be made at night from the "A" operator positions. The "A" operator will order up the trunks, one after the other to the lines used for testing incoming selectors, thus testing the cable pairs, selectors and ringing and supervisory relays. If the test is met successfully, the "A" operator will receive a distinctive flash.

Cordless "B" Sender Test Equipment (Automatic)

This is an automatic test equipment operating without attention until trouble is encountered. Sender selectors are used to

pick up the senders one after another to subject them to routine tests.

Subscriber's Line Test Box

The tests of subscriber's lines for continuity, breakdown and sleeve test cannot be made automatically since the deflection of a voltmeter must be observed. The test of the line finder is not made automatically. All these tests are to be made manually.

For picking up subscriber's lines, final selectors, specially wired, are used. They are available for handling ordinary calls except when in use for testing. Two finals per five hundred lines, one on each side of the last final frame in each choice, are adapted for these tests. This is done by adding two extra jacks and two extra cams each of these finals.

The test box is patched to a final selector by means of cord and jacks at the final frame. The final is then stepped to the subscriber's lines and tests to see whether or not is busy.

If busy, the final does not proceed. If the line is free, the final closes tip and ring.

If a continuity test is to be made the voltmeter will be connected and the throw of the needle observed.

Break-down tests will be made as with manual equipment.

If the line finder and line relay are to be tested, the sleeve will be opened at the test box and a high resistance thrown across tip and ring to test the line relay. If the line relay and line finder operate the dial tone will be heard by the tester. The non-operating current will also be placed on the cut-off relay and the tester should be able to operate the line relay and get the dial tone.

In connection with the voltmeter test, the cut-off relay will be tested with minimum current to make sure that it pulls up and closes tip and ring. The Make Busy resistance will also be tested for continuity. If a particular line finder is to be tested a test plug with ring and sleeve strapped is inserted in the test jack of that finder and the plug from the test box circuit is inserted in the test jack in the starting circuit.

The circuit operation is the same as on a regular call and the test box circuit is connected to the district selector when line is found.

It will also be necessary to make a mechanical inspection and special test of each line finder occasionally.

Subscriber's Sender Test Sets (Automatic)

This test will be entirely automatic so that when the test is started, senders will be picked up one after another without any attention from the maintenance force as long as the senders meet the test successfully. When a sender fails to meet the test, the test is stopped automatically and an alarm given.

Senders are picked up for test by special test sender selectors, these being in turn picked up by a master test selector. The circuit waits for a busy sender and gives an alarm in case the sender is busy too long.

The general operation of the testing circuit is to transmit to the sender, pulses to represent those normally coming from the subscriber's dial and to transmit to the sender, reverse control pulses such as would normally come from selector commutators and to

transmit to the sender, reverse control pulses such as would normally come from selector commutators and to receive direct control call indicator pulses.

The dial pulses will vary in speed to a somewhat greater extent than the limits set for subscriber's dial.

The conditions of subscriber's lines will also be simulated as to resistance, capacity and leakage.

The reverse control pulses will be sent in by a rotating commutator working at about 20% above normal speed and the sets of pulses will be sent very quickly one after another in order to detect any counting relays which fail to restore quickly.

The call indicator pulses sent out by the sender will be received by relay call indicator relays which must match with the pulses sent out.

The resistance and capacity of the trunk will be simulated but no leakage is to be used, since trunk leakage should be negligible. The coin senders will in addition be tested for coin collect and return operation.

District Selector Test Set (Automatic)

This is an automatic test which normally operates without attention, but stops and gives an alarm whenever a selector fails to meet the test. It also waits and measures off time whenever a busy selector is picked giving an alarm if the time exceeds a pre-determined limit. By throwing a key, the test set can be arranged to skip busy districts.

In order to pick up the district selectors, rotary line switches will be used. One such test switch per group of twenty district selectors will be needed.

In order to pick up the various test switches, master test switches of the rotary step by step type will be used.

The automatic test operates as follows:

When the start key is operated, a master test switch picks the brush leads of the test line switch having access to the first group of district selectors to be tested. The test line switch then moves to the terminals of the first district selector in the group. The test apparatus then tests the selector to see if it is busy. If it is not busy the test circuit is closed. This causes one of the regular senders in the office to become associated with the district under test. Pulses are then sent into the sender by the test equipment which set up the registers to direct the call to a group of test trunks on a district selector bank. The group of test trunks are cross connected to the testing equipment.

All features of the district selectors are tested, such as coin collect, message register, reversal of the trunk and test of the polarized supervisory relay and repeating coil in and out. Two special office codes will be needed for this purpose. The polarized relay will be tested over a maximum and minimum trunk resistance by the automatic test.

Full Mechanical Incoming Selector Test Set (Automatic)

The automatic test of full mechanical incoming will be made at the outgoing office. Test switches will be provided for picking up

such district selectors as are required to get access to all full mechanical outgoing trunks appearing on the district frames and such office selectors as are necessary to get access to all full mechanical trunks appearing on the office frames.

The test circuit causes the switch to pick up either a district or office selector as the case may be. The selector is then caused to select the group of trunks to be tested, and will pick up the first trunk in the group if it is not busy. If this trunk is busy, the test circuit is not closed and the testing mechanism will wait for a measured time interval for the trunk to become idle. In case the trunk does not become idle within this period, an alarm will be given. By throwing a key the testing mechanism can be made to skip busy trunks.

When the trunk has been picked, the incoming selector is caused to make a selection to a group of lines used for testing incoming selectors appearing on the final multiple of the incoming office.

The test lines are provided with test circuits capable of testing the ringing relays and the supervisory relays. The testing mechanism on these test lines will send back pulses to the testing circuit of the incoming selector in such a manner that if the ringing relays are tripped prematurely or fail to trip when they should, or the supervisory relay fails to operate or fails to fall off under the conditions of the test, the test circuit will be stopped and an alarm given at the outgoing office.

When the test circuit discovers a trouble, a maintenance man in the outgoing office will communicate with a maintenance man at the

incoming end, specifying the trunk in trouble and the nature of the trouble as far as he can determine it.

The district selector used for this test is a regular district selector which, when not employed for testing, is used for regular calls.

FINAL SELECTOR TEST SET (AUTOMATIC)

This is an automatic test set and makes use of the local incoming selectors as a means of patching the final selectors to the automatic test apparatus.

One local incoming selector having access to each sub-group of final selectors is used for picking the finals. These incoming selectors when not being used by the automatic test apparatus, perform the regular functions of local incoming selectors. Inter-office or cordless incoming selectors will be adapted for test purposes for picking those finals to which local incomings do not have access. Such inter-office or cordless incomings can be used for test purposes only.

Incoming selectors assigned for this purpose are wired to the automatic test apparatus. In the final multiple the three top lines in the top bank in each group of 500 lines are assigned as test lines. The reason for using three lines is for the purpose of testing the private branch exchange group hunting feature of final selectors. The test lines are cross-connected at the I.D.F. to the automatic test apparatus.

The test is entirely automatic in action, the method of operation being as follows:

Assuming the test to start in the first sub-group of final frame No.1. The test apparatus, when the start key is operated, chooses the incoming selector having access to these final selectors and makes the incoming busy to regular calls. The test apparatus then causes the incoming selector to make brush and group selection. In this case the number zero brush and group will be selected and then causes the incoming selector to pick the first terminal in the group. If this terminal is busy the test apparatus waits and counts off time. If at the end of a certain period, this trunk is not released, an alarm is given so that an attendant can investigate and find why it is being held; this time interval can be made to whatever length of time is found necessary. The circuit can also be arranged so that when the key is thrown the circuit will not wait for busy finals.

The test apparatus will apply a number of tests to determine whether the final selector under test is properly adjusted.

If, at any time, the final does not act as the test circuit expects it to, an alarm is given and the final is held.

After one final has been tested the local incoming selector is connected by the test circuit to the next in the group, etc.

This operation continues until all finals appearing in the first incoming bank are tested. The incoming selector is then returned to normal and again started, this time picking the second brush in front of the incoming.

After testing in one sub-group, another incoming in another sub-group is chosen; where the number of such groups is different in the different choices, arrangements are made not to test certain

finals oftener than others.

The test apparatus does not test all brushes on the final selectors. This could be done but it would require test lines in each bank. To test each brush, it is planned to use the portable selector test set. This box will be equipped with keys so that the test man can cause the selector to make tens and units selections on each brush.

FREQUENCY OF TESTS

The frequency with which a routine should be made is determined by a balance between the cost of making the routine, the amount of trouble found and the seriousness of the trouble as regards its reaction on the service. The results of the routine tests should therefore be examined critically from time to time to decide whether the frequency should be changed.

RECORDS

1. Manual Routines

In order to remind him when the routine to be carried out manually, should be started, the chief switchman will keep a "TICKLER File", probably one card for each month showing the various routines and the dates on which they should be started.

The chief switchman shall issue at the proper time to the man who is to do the work, a sheet entitled "Panel Switching Routine Tests".

In general, trouble discovered by routine will be cleared up immediately, and the routine tests, if necessary, made on the

equipment to make sure that the action has removed the trouble.

It will, however, be necessary occasionally to refer troubles to the apparatus man or relay man. Under these conditions the tester should make the apparatus busy and write a ticket, giving the location and appearance of the trouble.

These tickets, when several have been collected, will be turned over to the apparatus or relay man. These tickets do not form part of the numbered series made out of the trouble desk since they are not troubles which have been encountered by service calls.

The apparatus or relay man, after clearing troubles, should report to the man making the tests so that the action taken can be entered on the "Routine Tests" form.

These tickets form part of the records of the apparatus or relay man, and are turned in by them to a clerk who enters them on the reports entitled "Summary of Troubles Cleared".

The purpose of these records is largely to show whether enough trouble is found to justify the time spent; ie., whether the frequency of the routine is right. The chief switchman should therefore keep informed as to how much time is spent on each routine. The time spent on each routine which can be justified will vary.

More troubles will probably be found just after cut-over because of apparatus being new and because fewer calls are handled at this time by each piece of equipment and therefore a larger percentage of trouble is to be expected from dust and poor contacts.

2. Automatic Routines

Since the automatic routines will be in operation daily, it will not be necessary for the chief switchman to issue sheets.

every day, but he will delegate the duty of supervising these tests to the proper people.

The routine tests made automatically are kept track of as follows:

Each automatic test set is supplied with meters which tell the number of units (that is, selectors or senders) tested, the number of units passed over because busy, the number of individual tests and the number of complete cycles of tests.

The main purpose of the trouble records is to show whether the frequency of the tests is right. The routine testing apparatus which run almost continuously, is subject to considerable wear, and if very little trouble is being discovered, it can be kept idle for longer periods. The automatic routine test equipment shall not be operated during the busy hour.

ROUTINE INSPECTIONS

Adjustment and Inspection of Sequence Switch Drive Plates Work To Be Done By the Apparatus Man

First: Make sure the circuit of the switch to be adjusted is made busy, then remove the fuses which are individual to the circuit.

Second: Examine the contact surface of the driving and driven drive plates which should be completely covered with a good friction surface and free from bright spots. On a slow or slipping switch whenever any part of the driving surface is bright it should be thoroughly cleaned by rubbing with a piece of cheesecloth soaked in carbon tetra-chloride after which water should be applied a drop at a time; then allow switch to stand idle until rust appears.

Several applications of water may be required to form a coating of rust on this surface, but excessive rust should be avoided.

If there is any indication of oil or grease on a plate, it should be thoroughly cleaned, using a piece of cheese cloth soaked in carbon tetra-chloride. Special attention should be given to the driving plates directly above and below the driving shaft bearings, as oil from these bearings will sometimes work its way up and down on the surface of the shaft to the plates.

Inspect top and bottom surfaces of these plates for any traces of oil or grease.

Any loose rust, dust or dirt found accumulated on top of the driving plate should be removed by using a piece of cheese cloth soaked in carbon tetra-chloride.

When cleaning plates two changes of cloth are a necessity, one to be used for a rough cleaning, and the other to finish with.

Do not touch the contact surface of the plates with the hands as the oil from a person's skin is sufficient to cause a disc to slip.

Note: For cleaning sequence switch plates use only carbon tetra-chloride designated as "Technical". This should be free from oil or grease and can be tested by wetting the hands or fingers with it, when it should quickly evaporate and leave the skin a mottled white.

Third: In an assembled switch the cam shaft bearing pin should be so adjusted as not to bind; i.e., the cam shaft should have about .003 of an inch end play in its bearings. This can best be adjusted by setting the bearing pin so as to leave no end play

and partly tighten the clamping screw, then tap the end of switch frame which is holding the bearing pin with a screw driver until the desired amount of end play is obtained. Tighten clamping screw securely and again check the end play as the bearing pin will sometimes move when tightening the clamping screw. When inspecting for end play, just enough pressure should be put on the shaft to overcome the pressure of the switch springs but not enough to spring the frame.

Fourth: Inspect the driving disc for running true. This is done by rotating the switch by hand and at the same time noting the gap between the driven disc and the switch frame, which should be from .024 of an inch to .034 of an inch. If the gap is large, bend spider towards "R" magnet, while if it is found to be small, bend spider towards the cams of switch.

Fifth: Inspect for air gap between the driving and driven discs. The best way to determine the correct gap between these discs is by the eye, using gauge only occasionally to check the eye. Hold a lamp so that it illuminates the top mounting ear of the switch directly below the one to be adjusted, but shielded from the eye, then place eye in line with the surface of the driven disc and sight through the gap toward the illuminated ear (the ear, being galvanized, forms a light back-ground; when there is no switch mounted directly underneath the one to be adjusted use a piece of white paper for a back-ground). Now revolve the switch and note the air gap, this gap is adjusted by moving the whole switch frame. The gap between the driving and driven discs shall be as small as possible without touching with the driving shaft and sequence switch in any position

about the axis, and shall not be more than .020 of an inch when the shafts are in the positions, which bring the discs farthest apart. The vertical driving shaft should be revolving while adjusting the gap between discs.

Note: On routine inspection do not change the adjustment until the discs rub together or the gap between discs exceed .020 of an inch.

Sixth: The driving disc should be set on the vertical shaft so that it does not come in contact with the magnet shoe and the maximum gap between the closest point on magnet shoe and disc shall be .010 of an inch.

Seventh: Short-circuit the "A" cam contact springs by inserting the "A" cam short-circuiting tool. Then replace the fuses and allow the switch to revolve a few minutes for the purpose of grinding in the contact surfaces of the driving and driven plates.

Before removing the short-circuiting tool, apply slight friction to the switch by placing a finger on the index plate to see if this will cause any appreciable slipping between the driving and driven plates. When there is found to be any slipping the condition of the plates and their adjustment must again be checked and the cause for slipping eliminated.

The following inspection and adjustment of sequence switch springs should be made in the order in which they are given. (Note: The edge of cam which first comes in contact with the springs when the switch is rotated will be called the front edge, and the edge of cam they break from, will be called the rear edge.)

Cams should be centered between springs on each side of them. Adjustment is made by moving the spring assembly.

Rotate switch, and whenever the springs are on the insulation part of the cams, there should be a good clearance between the inner springs and the inner or outer radius of the inner cam cutting and also between the outer cam cutting to preclude the possibility of the springs making false contact with the cams. Adjustment is to be made by moving the springs on the spring assembly. After moving a spring it will be necessary to tighten the screws in the assembly which may be done either by the use of an offset screw driver or by removing the bracket from the frame while tightening the screws.

Inspect all contact springs for tension which should be minimum thirty, maximum forty-five grams, when in contact with the metal part of cam.

Note: Make a small pick about six inches long, out of a piece of wood or fibre to be used for inspecting tension of contact springs. Hold pick in hand as a lead pencil and with the pointed end near the contact portion of the spring, lift the spring away from the cam. The spring tension from thirty to forty-five grams, can readily be determined by the sense of feeling, after a little practice.

For the purpose of acquiring a good judgment of the correct tension, test a number of springs by using the tension tool, and after testing each spring use the pick and feel their tension. Unless the sequence switch has a tendency to slip, it will not be necessary to reduce the spring tension to forty-five grams.

To inspect the adjustment of springs and cams in reference to making and breaking contact, (1) move switch until the center of the spring is on the front edge of the "A" cam and then note on all other cams which springs break from a regular cutting in the position from which the switch is now being moved out of.

(2) Move switch until the center of the "A" spring is on the rear edge of the "A" cam, and then note the amount of contact all other springs have on cams which make on a regular cutting in the position which the switch is now being moved into. Make this inspection on several positions of the switch.

The amount of the average contact which the springs have on the cams in the first test should be approximately the same as in the second. When it is found that they are not equal, adjust by bending the "A" contact spring so as to bring its contact portion forward or back as the case may be. Bend the "A" spring only at its angles and be sure to leave it with the proper spring tension.

Make a check to see that the springs make and break contact correctly with each cam cutting. To do this start with the switch in the first position and move it forward until the center of the "A" spring is on the front edge of the "A" cam, with switch in this position all cams from "B" to "X" inclusive, which are out in position one, should make contact with their respective springs. (This may be checked in order to determine whether any spring has broken contact with its cam, by delicately attempting to turn the switch in the reverse direction. Great care must be used in moving the switch backwards since any spring which may have broken contact with its cam will tend to avoid backward rotation and will con-

sequently be damaged by further movement. This tendency to impede the reversing of the switch permits the spring to be located and adjusted). Now move the switch forward again until the center of the contact portion of the "A" spring is on the rear edge of the "A" cam; with switch in this position, all cams from "B" to "Y" inclusive which are out in position 2, should make contact with their respective springs.

The making and breaking of contact springs on cams having $1/4$ or $1/2$ cuttings can be checked by the eye. Knowing the position of the springs on a cam having a regular cutting, it will be seen that a cam which proceeds with a $1/4$ cutting should make a five degrees or $1/2$ the width of a regular cutting, sooner than a cam having a regular cutting, etc.

Repeat the above operation through all positions in which the "A" cam is cut. Adjustments may be made by a slight bending of the springs, but if much bending would be required the cam should be moved on a shaft instead. When it is found necessary to move a cam on the shaft the cam clamping nut should be slightly loosened by holding the index plate with a tool and turning the nut with the clamping nut wrench.

Hold adjacent clamps and move the cam desired. After setting cam in the proper position, hold clamping nut with wrench and tighten by turning the index plate until spring on wrench is compressed about $1/8$ of an inch. Use care so as to never move the switch backward as this may damage a spring. Whenever a cam has been moved or a spring adjusted on a switch then all positions in which the "A" cam is cut, must be re-checked.

With the roller of the "A" spring in the corrugation of the cam, the front edge of the "A" spring should clear the rear edge of the "A" cam minimum .017 (thickness of the "A" contact spring), maximum .034 (twice thickness of contact spring). It is preferable to have the above adjustment in the minimum clearance. This adjustment is made by bending the roller spring using the "A" cam roller spring adjusting tool.

The tension of the roller spring should be from four hundred to six hundred grams. This tension is checked by a gauge provided for that purpose.

Rotate switch by hand to see if the "A" roller revolves freely. If it does not turn or appears to be dry, apply a small quantity of watch oil at the top of the roller bearing. Apply the oil with a sharp pointed toothpick and use great care so as to not leave any oil on the top surface of the roller or allow any to run through to the bottom of the spring.

A small amount of oil may also be applied to the right hand end cam shaft bearing, if it appears dry.

It is proposed to make the following inspection:

Sequence Switches

(a) General	annually
(b) Drive Plates	monthly

Selectors

Multiple Brushes	annually
Commutator Brushes	
Trip Fingers	
Commutators	
Rotary Switches	annually
Interruption	monthly
Cleaning Commutators	(see note)

Note: The frequency will vary according to the humidity from once per day in very humid weather to once a month when the building is heated.

ROUTINE CHECKS:

Relays

It is proposed to check the adjustment of relays as outlined:

- | | |
|---|------------------|
| 1- Millimeter check of counting and stepping relays | Annually |
| 2- Millimeter check of Subscriber's line and cut-off relays | Semi-annually |
| 3- Millimeter check of final selector P.B.X. relays | Annually |
| 4- Millimeter check of other relays | Every two years. |

Other Apparatus

- | | |
|--------------------------|---------------|
| 1- Clutches | Annually |
| 2- Translators | Semi-annually |
| 3- Other Rotary Switches | Annually |

SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- What different parts of machine switching equipment require routine testing?
- 2- Describe briefly the uses of each testing circuit.
- 3- In the final multiple how many lines are assigned for test lines and where are they located?
- 4- What happens if the final selector does not act as the test circuit expects?
- 5- How are the routine tests made automatically kept track of?
- 6- How will the dial pulses from the "Subscriber's Sender Test Set" compare with the pulses sent from subscriber's dials?
- 7- What is used to test each brush on the final selector?

SEQUENCE SWITCH

- 8- What should be done to a circuit first before adjusting a sequence switch?
- 9- How should a slow or slipping switch be taken care of?
- 10- How should plates be cleaned?
- 11- How should you inspect for air gaps between driving and driven discs?
- 12- When is the "A" cam short circuiting tool to be used?
How should all contact springs be tested for tension?
- 13- How is the tension of the roller spring checked?

PLANT SCHOOL

SEATTLE WASHINGTON

PANEL MACHINE EQUIPMENT

LESSON NO 20

SUBJECT

METHOD OF TAKING EQUIPMENT OUT OF SERVICE

AND

APPARATUS REPLACEMENTS

LESSON NO. 20

METHOD OF TAKING EQUIPMENT OUT OF SERVICE

TRIP CIRCUIT

(a) Remove plug from regular trip circuit jack and place in the emergency jack. Calls advancing through the trip circuit at a time when the circuit is taken out of service will be picked up by the emergency trip circuit in the same manner as a new call. The equipment in the circuit taken out of service if operated at that time will function in the same manner as on an abandoned call.

(B) To restore to service, remove plug from emergency jack and place in regular trip circuit jack. This jack is on the line relay frame.

START CIRCUIT

(a) Remove plug from regular starting circuit jack and place in emergency jack. Calls advancing through the regular starting circuit at the time an emergency starting circuit is placed in service will be picked up by the emergency starting circuit as a new call and the equipment in the regular starting circuit and associated circuits beyond will function as on an abandoned call.

(b) To restore to service remove plug from emergency jack and place in regular start circuit. This jack is also on the line relay frame.

LINE FINDER

(a) If the line finder is at a normal position, place an

M.B. plug in the line finder M.B. jack which will make the line finder test busy.

(b) If the line finder is off normal and the district is in talking position, place an M.B. plug in the line finder M.B. jack and the line finder will be restored to normal and made to test busy when the calling subscriber hangs up. Should the trouble be of such a nature as to prevent release of the line finder, wait until the conversation is over and check the district selector to make sure that it has been restored to normal and then reset the line finder by hand. If the district selector has not been restored to normal, rotate the district selector sequence switch to position 18 by hand when the selector should return to its normal position restoring the equipment beyond. If the line finder is off normal, after the district selector has returned to normal, reset it by hand.

(c) To restore to service, remove the plug from the line finder M.B. jack.

(d) To take line finders out of service by half frames, operate the motor stop key at the trouble desk to restore to service restore frame busy key at the trouble desk.

DISTRICT SELECTOR

(a) If the district is at its normal position, place a make busy plug in the make busy jack of the associated line finder.

(b) If the District Selector is in a talking position, place a make busy plug in the make busy jack of the associated line finder. The selector will be restored to normal when the calling subscriber hangs up. Should the trouble be of such a nature, however, as

to prevent release, wait until the conversation is over and then move the district sequence switch to position 16 by hand, when the selector should return to normal.

(c) If the district selector has chosen a trunk but has not advanced to the talking position, make busy, trace the connection, and determine whether the office and incoming are involved. If an office selector is found to be involved, and has not chosen a trunk to an incoming selector, move its sequence switch into position 11 by hand. If the office selector restores to normal from this position after a moment, it will indicate that the district selector has also been restored. If the office selector fails to restore from position 11, return to the district selector and revolve the district selector sequence switch to position 18 by hand. If the office selector has chosen a trunk to an incoming, trace the connection and if the incoming sequence switch is found to be in some position preceeding position 9, turn sequence switch into position 9 by hand. The incoming selector should restore after a moment. If it does not, or if it restores and immediately takes up another stuck setting, turn the incoming sequence switch to a talking position and then return to the district selector and move the district selector sequence switch into position 18.

(d) If the District is off normal but has failed to pick a trunk, place a make busy plug in the make busy jack of the associated line finder, reset the brush if opposite a multiple terminal and move the district sequence switch to position 18 by hand. To restore to service remove the make busy plug. To take district selectors

out of service by half frames operate frame busy key at the trouble desk. To restore to service, restore frame busy key at trouble desk. The motor stop circuit is not always arranged to take district selectors out of service by half frames.

OFFICE SELECTOR

Methods of taking out of service are practically the same as for the district selector.

FULL MECHANICAL INCOMING TWO-WIRE TO TAKE OUT OF SERVICE

(a) If the selector is at normal or in a talking position, place a make busy plug in the make busy jack at the trouble desk.

(b) If the selector is not in a talking position, place a make busy plug in the make busy jack at the trouble desk and release as described in paragraph "c" under "District Selectors". To restore to service remove the make busy plug at the trouble desk.

FULL MECHANICAL INCOMING THREE-WIRE

To take out of service with the selector in any position, place a make busy plug in the make busy jack. Should the selector be in a selecting position, release as described in paragraph "c" under District Selectors. To restore to service remove the make busy plug.

FINAL SELECTORS

To take out of service, selector in any position, place a make busy plug in the make busy jack of the selector. If the selector is in a selecting position, move its sequence switch to a talking pos-

ition. If the selector restores to normal after a moments delay, it will indicate that the other selectors in train have also been restored to normal. If release does not take place, trace the call or connection back to the district and release by moving the district sequence switch to position 18 by hand. To restore to service, remove the make busy plug.

SUBSCRIBER'S SENDERS

To take out of service, place a make busy plug in the sender make busy jack at the trouble desk. If the sender is stuck, trace the connection and release. To restore to service remove the make busy plug.

CORDLESS "B" SENDER

Place a make busy plug in the make busy jack at the trouble desk. If the sender is stuck trace the connection after making the sender busy, and release by restoring the sender selector to the waiting assignment position by hand. To restore to service, remove the make busy plug.

CORDLESS "B" LINK CIRCUIT - TAKE OUT OF SERVICE

(a) Sender selector in position No.1.

Operate make busy key at the sender selector frame. Note that the allotter moves to assign the next idle sender selector.

(b) Sender in position No.17.

Operate make busy key.

(c) Sender selector in a selecting position.

Wait until sender selector sequence switch reaches position No.17 and operate make busy key.

(d) Sender selector stuck in a selecting position.

Operate make busy key and note that allotter moves, or has moved, to assign the next idle sender selector. To restore to service restore make busy key.

CORDLESS ALLOTTER NO.1

(1) Operate the make busy keys at all the idle sender selectors controlled by allotter No.1. As the busy sender selectors controlled by allotter No.1 become idle operate their make busy keys also.

(2) When the make busy keys of all sender selectors controlled by allotter No.1 have been operated, remove connecting plug "I" from regular position, (turn it over) and insert it in the trouble position.

(3) Restore sender selector make busy keys.

TO RESTORE ALLOTTER NO.1 TO SERVICE

(1) Wait until all sender selectors controlled by allotter No.1 are idle and then restore their respective busy keys.

(2) Remove connecting plug "I" from trouble position, turn it over, and insert in the regular position.

(3) Restore sender selector make busy keys.

ALLOTTER NO.2 - TAKE OUT OF SERVICE

To take out of service is the same practically as for No.1 allotter, except that K jack is used and when taken out of a regular position, and inserted to a make busy position, it is turned over.

CORDLESS "B" KEY SET

To take out of service, remove regular key set from key

shelf and replace it with emergency key set.

CORDLESS KEY CONTROL CIRCUIT

(1) To take No.1 key control circuit of any position, out of service, remove regular plugs from jacks C, E and F.

(2) To take No.2 key control circuit of any position, out of service, remove regular plugs from jacks D, G and H.

To replace key control circuit No.1 of any position with key control circuit from another position, connect C E F jacks of position in trouble to jacks C E and F of another position with patching cords, provided for this purpose. Follow the same proceeding for key control circuit No.2, except using jacks D G and H.

APPARATUS REPLACEMENTS - SEQUENCE SWITCH REPLACEMENT

The parts of a sequence switch which can be replaced or changed separately are as follows:

R magnet
Springs
Cams

To Remove R Magnet

Make circuit which includes the sequence switch busy, unsolder the wires from R magnet terminals. Loosen the two screws on the back edge of inside plate which fastens the magnet to the sequence switch frame using an off-set screw driver from the rear of the frame. The magnet can now be removed from the frame.

Mounting R Magnet

See that the rear screws on the frame are out far enough to allow the magnet plate to slip under the heads. Place the magnet in position with the best coil plate down and place the two front

screws in the frame through the magnet plate. Tighten up on these screws, being careful to see that the bent plate is parallel to the drive plate on the vertical shaft and in accordance with Lesson on "Adjustment". Now solder wires on the R magnet terminals.

To Remove Spring Nests

Make circuit busy and remove fuses, unsolder wires at the brush terminals of the nests to be removed, remove the screws and washers from the rear of the sequence switch frame holding the nest. Lift the nest out of the cam assembly from the front of the frame.

To Place Spring Nests

Tighten the assembly screws of the nest with the springs parallel. Place the spring nests above the cams with the spring entering in front of, and parallel with, the cams and with the terminal end toward the rear. Slightly spread the springs so that they can be placed on the cams and at the same time push the nest toward the back of the frame. The nest will come to rest at the proper place when the rear of the frame is reached. Fasten in place from the rear with the screw and washer provided. The spring nest should be centered horizontally in accordance with previous lesson on "Adjustment". Solder the wires on the spring terminals.

To Remove Cams

Make circuit busy and remove fuses. Loosen clamping screws on right end of switch frame. Hold assembled cam shaft in the left front and pull the bearing out a little to the right. Move assembled cam shaft to the right enough to have the left end of the cam shaft clear the left bearing. Draw the cam shaft assembly with cams and

plate away from the springs. Mount cam shaft assembly in #225 tool and clamp the driven plate at a convenient point preferably so that the straight edge may be placed opposite the edge of a cutting on a cam to be retained on the shaft which corresponds to a similar cutting on the new cam or cams to be added. Mark reference line on edge of cams with #240 tool. Unscrew cam clamping nut with #236 tool while holding index wheel with #203 tool. Remove cam shaft assembly from #225 tool and remove clamping nut holding cams and collar in place. Hold cam shaft vertically over tip of #358 tool and transfer cams and collars to spindle until cam to be removed is transferred, being careful to retain removed cams in alignment on spindle. Make change of cams on spindle of #258 tool, being careful to arrange cams so that all rivet heads will be towards the index wheel end when assembled. Transfer the necessary cams from spindle to cam shaft preserving the cam alignment in the process. Add necessary washers and index wheel in proper position on shaft, mount cam shaft assembly in #225 tool and rotate it to center spacing collars on shaft. Clamp shaft at convenient point and bring marked cams into alignment by bringing scriber marks to the straight edge of #225 tool. Bring previously chosen edge of cutting on new cams into alignment on straight edge, if possible, in this position of cam shaft align new cams by reference along straight edge to marked cams having cuttings in same position which corresponds to cuttings on new cam. Tighten cam clamping nut, using #203 tool as before. Check alignment of cams before removing cam shaft from #225 tool. Place the assembled cam shaft with cams under springs and turn the whole towards you, at the same time raising the

left end of the assembly so that the cams enter between the springs and permit the left end of the shaft to slip into the left bearing. Continue turning the shaft and raise the right end until all cams have entered between their proper springs and then push the right bearing into the end of the shaft. Adjust end play per section on adjustment. Inspect all cams and springs as described in previous section on inspection and adjustments.

PLANT SCHOOL

SEATTLE WASHINGTON

PANEL MACHINE SWITCHING EQUIPMENT

LESSON NO. 22

SUBJECT

TROUBLE DESK
SENDER MONITOR

LESSON NO. 22.

TROUBLE DESK - SENDER MONITOR

PART 1

GENERAL

At the trouble desk appear the alarms and signals provided to indicate troubles of various kinds affecting the machine switching equipment. At this desk means are provided for removing outgoing trunks (Inter-office) from service individually in case of trouble and for testing the trunk conductors. The traffic force reports to this point any equipment trouble, and the maintenance force any outgoing trunk which must be taken out of service. In short the Trouble Desk might be described as "trouble headquarters for machine switching equipment." Trouble tickets serially numbered for each day, beginning at twelve midnight, are made out by the sender monitor or the desk switchman for each case of trouble reported, located in the central office mechanism. It is the desk switchman's duty to assign the tickets and when they are returned to see that the trouble has been properly cleared and that the "class" in which the trouble found belongs as given in Trouble Records, is noted on the tickets. Where the cause is not found the ticket should show the appearance to the switchman and classification made accordingly. A log book is kept in which should be entered such occurrences as blown fuses (except those blown by maintenances men), operation of District Frame time alarm, Final Frame Time alarm, Line finder alarm, Power plant irregularities, Clock Circuit, Trouble and other circumstances having a bearing on the service by machine switching equipment.

Face Equipment Subscribers Sender Supervisory Equipment

Each sender is represented by -

A Designation strip

A Make Busy Jack

A Test Jack

A Lamp (White Cap)

A Lamp (Red Cap) (Coin Senders only)

The designation strip has the number of Sender involved.

A Make Busy jack is associated with each test jack of each sender.

The White Lamp and Red Lamp associated the class of service and denote on their condition of illumination what the trouble may be.

KEY SHELF EQUIPMENT

Talking Cords.

A Supervisory Lamp

A Talking Key

A Flash Key

A Coin Return Key (R)

A Coin Collect Key (C)

A Cord With Plug.

For handling the different cases of trouble at subscriber's station or handling trouble condition indicated by the lighting of sender lamps at trouble desk by sender monitor consult Page 3 - Operation Index where numerous conditions are set up and the phrases used by sender monitor. It is absolutely necessary in order to release the subscriber's line and Sender involved for the sender monitor to momentarily insert the cord with plug in the M.B. jack after his conversation with subscriber. In case of trouble on subscriber's line that cannot be cleared by sender monitor after one half minute in which he challenges a plugging up circuit is used for that line.

CLASS SENDER	TROUBLE	WHITE	RED	CAUSE: Ans. Rec. - Action to be taken	
COIN OR NONCOIN	PERM. SIGNAL	STEADY BRIGHT		a) Does not Dial	See page #4-a #1
				b) Dialing Delayed	" " b #1-2
				c) Sticky Dial	" " c #1
				d) Dial Properly	" " d #1-2-3
				e) No Dial Tone	" " e #1
				f) Coin Box	" " f #1
				No Ans. Rec.	
				a) After $\frac{1}{2}$ min.	See page #5-a #1
				b) A # Perma. Sig.	b #1
COIN OR NONCOIN	PARTIAL- LY DIALED NO.	STEADY DIM		ANS	SEE PAGE #6
				NO ANS.	" " #7
COIN OR NONCOIN	STUCK SEND- ERS	FLICK- ER		ANS	" " #8
				NO ANS.	" " #9
COIN	NON- DEPOS- ITED COIN	FLICK- ER	FLASH	ANS	" " #10
				NO ANS.	" " #11
COIN	NON- COLLECT- ED COIN	STEADY BRIGHT	STEADY BRIGHT	ANS	" " #12
				NO ANS	" " #13
COIN	NON- RETURN- ED COIN	FLICK- ER	STEADY BRIGHT	ANS	" " #14
				NO ANS	" " #15

CHALLENGE "REPAIR CLERK"

#1 (Answer received) - What number are you calling? What is your number?

- (a) Subscriber does not know how to dial.
- (b) Dialing has been delayed.
- (c) Sticky dial.
- (d) Subscriber did dial properly.
- (e) No dial tone.
- (f) In case of coin box.

(a-#1) "To make a call at the telephone where you are, it will be necessary to operate the dial at the base of the telephone as required by number which you wish to call. Instructions as to how to dial are in the directory. Will you consult them, please?" If the subscriber is still perplexed, sender monitor should instruct subscriber.

(b-#1) "By not dialing promptly after hearing dial tone the apparatus is placed in trouble. Will you not dial promptly after hearing dial tone, please? In a moment you will hear dial tone. Will you dial then please?"

(b-#2) Sender monitor inserts plug in KB jack momentarily to release line and sender.

(c-#1) If the subscriber's dial does not work properly being sticky, S.M. will say "Will you hang up, please. A repairman will be sent as soon as possible to repair telephone."

(d-#1) There is some trouble on the line.

(d-#2) "Will you hang up and in a few moments dial again, please?"

(d-#3) See #1 (b-2).

(e-#1) If no dial tone is received S.M. releases line, makes out a trouble ticket; if trouble is in Sender, stating number of sender in trouble.

(f-#1) If coin box (and coin deposited) S-M will depress the (R) coin return key.

#2 (No Answer Received)

(a) After one half minute.

(b) A considerable number of permanent signals.

(a-#1) See #1 part (b-#2)

(b-#1) See #1 parts (b-#2) and (c-#1)

#3 (Answer received) See #1.

(a) Partially dialed numbers CA930 and WE-21.

(b) If subscriber dialed correct numbers.

(c) In case of calling special operators.

(d) Unfinished dialing

(e) Repeated partially dialed numbers.

(A-#1) See #1 part (a-#1)

(B-#1) See #1 " (d-#1)

(C-#1) Subscriber to be instructed.

(D-#1) "Because you have not dialed your number one digit after another the call has gone wrong. Will you hang up, Please" and in a few moments dial again, please?"

(E-#1) See #1 part (C #1)

#4 (No Answer Received)

(a) operation

(b) Sender lamps repeatedly light.

(A-#1) See #1 part (b-2)

(E-#1) (Same as above) on each line. Report to desk switchman (trouble ticket to be made out.)

#5 (Answer Received) See #1.

(a) Stuck Sender

(b) In case of Coin Box.

(A-#1) See #1 part (d-#2 and B-#2)

(B-#1) See #1 part (f-#1-

#6 No Answer received.

(a) Stuck Sender

(b) Repeated Stuck Senders

(c) In case of coin box.

(A-#1) See #1 part (b-#2)

(B-#1) Sender monitor should keep a running record giving subscriber's number and sender number, also make out a trouble ticket for each case for desk switchman.

(C-#1) Sender Monitor depresses, (c) key coin collect.

#7 Answer Received See #1.

(a) Coin not deposited.

(b) Coin signal comes in again (Red Lamp).

(c) If subscriber insists money has been deposited.

(d) Trouble with testing apparatus.

(e) Repeated trouble.

(f) Plugging up circuit.

(A-#1) "The signals indicate that your call is held up because the required coin has not been deposited. Will you deposit the coin, "Please?"

(B-#1) S M will say, "Will you hold the line a moment, "please?"
S M operates the (R) key coin return.

(C-#1) S M will obtain his name and address saying the money due him will be mailed to his address.

(D-#1) S M will say "I have returned your money will you hang up,
and in a few moments dial again. "please"?

(E-#1) See #6 part (b-#1)

(F #1) After the sender monitor releases line and sender he should
call repair clerk giving line number (coin line etc) the
latter should assign a plugging up circuit for this line from
the group set aside for this purpose.

#8 No Answer Received.

(a) Operation

(b) Repeated signals

(A-#1) Sender Monitor operates (c) key coin collect

(B-#1) See #7 part (f-#1)

#9 Answer Received- See #1

(a) Operation

(b) Beating

(c) In case of correct signals

(d) In preceeding cases

(A-#1) Sender Monitor operates (C) key

(B-#1) SEE #1 part (d-#1)

(C-#1) See #1 " (A-#2)

(D-#1) See #1 " (f-#1)

#10 No Answer Received.

(a) Operation (Beating)

(b) What Sender Monitor Should understand from signals
if beating is indicated.

(c) Repeated signals.

(A-#1) Sender Monitor should operate (c) key

(B-#1) Notify the proper authorities

(C-#1) See #7 part (f-#1).

#11 Answer Received- See #1

- (a) Before Number dialed has completed its function.
- (b) If improper signals are received.
- (c) If proper signals are received.
- (d) If subscriber insists the money was not returned.
- (e) In case coin stuck in coin box.

(A-#1) See #7 part (b-#1)

(B-#1) See #1 " (d-#1 and d-#2)

(C-#1) Sender Monitor says, "I have returned your money, will you hang up "please."

(D-#1) See #7 part (C-#1)

(E-#1) Sender Monitor will say, "There is some trouble on your line, are you the proprietor or will you have the proprietor come to the telephone, please." If able to talk to the proprietor he will say, "Will you hang an Out of Order sign on the telephone, please, and use some other telephone, please. A repairman will be sent to fix it as soon as possible." (Pertains to attended Pay Station also.)

#12- No Answer Received.

(a) Operation

(b) Signals come in again.

(c) In case of Ground on tip of line. (other than coin box).

(A-#1) Operate (R) key coin return.

(B-#1) See #1 part (b-#2) and make out trouble ticket.

(C-#1) See #7 part (f-#1).

CORDLESS B SENDER SUPERVISORY EQUIPMENT.

PART NO. 2

GENERAL

The Cordless B Sender Supervisory Equipment which is located on the face of the Trouble Desk before the Sender Monitor is as follows:

A Designation Strip

A Make Busy Jack

A Lamp (White Cap)

The designation strip has the #s of the senders serving cordless B operators. The Lamp ~~which~~ is lighted when sender is selected by cordless B operator denotes ~~an~~ its different illuminations to the sender monitor after an interval of time that there is trouble with sender and should make out a trouble ticket giving the number of sender and the condition of its lamp. The make busy jack associated provides a means for taking the sender out of service after a repeat of two or three times of an abnormal condition. If a cordless B position is out of service or if a call is blocked after "key release and the operator cannot wipe out (with her "Wipe Out" key) the number of the sender which may be involved can be ascertained by observing the sender lamps and noting the one which remains lighted in the same condition for an interval longer than 10 seconds. The action to be taken when a cordless B position is out of service depends on what the tracers who are assigned find abnormal, if keys the emergency set are used: if key control replace by another key control circuit from an unoccupied position.

CORDLESS "B" SUPERVISORY OF SENDER AT TROUBLE DESK

SENDER MONITOR

<u>SENDER</u>	<u>WHITE LAMP</u>
:	: Steady
:	: Dim
: <u>SENDER ATTACHED TO KEYBOARD</u>	:
:	:
: <u>SELECTION BEYOND</u>	: Flicker
:	:
: <u>Disc. Premature or regular</u>	: Steady
:	: Bright
:	:
:	:

DESCRIPTION

Each sender of the Cordless "B" positions has a White Lamp located on the face of the trouble desk before the Sender Monitor. Associated with this is a Make Busy jack. As soon as a sender is selected the lamp is lighted. The different illuminations (see figure above) of the lamp denotes, after an interval longer than ten seconds, an indication of trouble. If any sender repeats two or three times in a short interval, a Make Busy Plug is inserted in the Make Busy Jack and a Cordless "B" trouble ticket is made out, giving the number of the sender and the condition of the lamp illumination. On a report from the Traffic Department, who will notice abnormal conditions on Cordless B sender's, the sender monitor should then closely supervise the sender lamps for five or ten minute periods and make a note on senders which are stuck.

ALARM PILOTS

GENERAL

For the purpose of enabling the desk switchman to have a means of knowing when any of the more important parts of the machine

switching system other than those covered by the lighting of the various sender lamps have become in-operative, and for enabling him to know whether the floor switchman and powerman have remedied the trouble, alarm pilot lamps are provided which indicate:

1- When fuses are blown on:

Subscriber's district and cordless "B" Incoming Frames.

Subscriber's sender and cordless B Sender frames.

Line Finder Frames

Office Frames

Incoming Frames

Final Frames

Coil Hooks (A and B)

Line relays

Miscellaneous Bus Bars

Distributing fuse panels

Night Alarm Circuit "A" switchboard.

2- When the Machine Switching apparatus is stuck at such stages of progress that the sender does not give an alarm or that an operator does not receive an indication of the trouble. For these cases there are provided the following:

Subscriber's district selector time alarm

Final selector time alarm.

Line Finder Time alarm.

3- When any drive motor stops. For these cases there are provided the following:

Motor stop alarms and guard lamps for:

Line Finder Frames

District Frames

Office Frames

Final Frames

Subscriber Sender Frames

Cordless B Sender Frames

Frame Make busy lamps for Subscriber's
line Finder Frames.

4- When power plant irregularities are encountered because of:

Blown charge or discharge fuses

Abnormally high or low battery voltage

No ringing current voltage

Operation of circuit breaker

Phase failure

5- When the electric clock fails

6- When the automatic routine test equipment is blocked.

The initial action in remedying the trouble indicated by the lighting of any of these alarm pilot lamps is to be taken by the switchman or powerman on the particular floor on which the trouble occurs. In order that this procedure may be carried out the alarm system is arranged so that there are alarm pilot lamps on each floor for the apparatus on that floor. These alarm pilot lamps are mounted on a special panel called the floor alarm board, except for the floor on which the trouble desk is located where these lamps are located in the latter.

While the floor switchman or powermen are to take the initial action in clearing the trouble indicated by the lighting of these pilot lamps, the desk switchman is to have general supervision to see

that no alarm is left unattended for any appreciable length of time. When the desk switchman at times of light load or periods of relief is aware that no attendant is near the apparatus in trouble, he should at once assign some one to remedy the trouble. The desk switchman should enter in the log book all reports of trouble indicated by the alarm pilots together with the trouble found by the floor switchman. As an exception fuses blown by maintenance men should be disregarded.

BLOWN FUSES ALARM PILOT LAMP-SELECTOR FRAMES

A pilot with a white cap is provided at the trouble desk for each floor, for all of the fuses on the selector frames on that floor. In addition, for the floor on which the trouble desk is located there is also provided a pilot lamp with a white cap for each of the types of frames on that floor that is, one for the subscribers district frames, one for the office frames and one for the subscribers gender frames, etc. A blown fuse lights the lamp, and the removal of the blown fuse puts out the lamp.

BLOWN FUSE ALARM PILOT LAMP - COIL RACKS

LINE RELAY FRAMES, MISCELLANEOUS FUSE BUS BARS

A lamp with a white cap is provided at the trouble desk for all of the equipment of this type which is on each floor. A blown fuse lights the lamp and the removal of the blown fuse puts out the lamp.

BLOWN FUSE ALARM PILOT LAMP - DISTRIBUTING PANEL

A pilot lamp with a white cap is provided at the trouble desk for each distributing panel on each floor. A blown fuse lights the lamp and the removal of the blown fuse puts out the lamp.

BLOWN FUSE ALARM PILOT LAMP, SUBSCRIBER'S SWITCHBOARD NIGHT ALARM CIRCUIT.

One lamp with a white cap is provided for indicating a blown fuse in the night alarm circuits for the subscriber's switchboard. A blown fuse lights the lamp and the removal of the blown fuse puts out the lamp.

SUBSCRIBER DISTRICT SELECTOR TIME ALARM PILOT LAMP

There is one pilot lamp with a white cap for all of the districts frames on each floor. In the circuit there is a device for measuring off a pre-determined time interval which is long enough to allow the selector to perform its normal functions. If, after the lapse of this interval, the normal functions of the selectors are not completed, the pilot lamp is lighted indicating a stuck selector.

The desk switchman should understand by the lighting of this lamp that one of the district selectors on the corresponding floor indicated by the marking on the designation strip is stuck due either to equipment trouble, plant trouble or failure to disconnect by the subscriber. The pilot lamp becomes lighted usually only when a selector is not associated with the district selector. It is extinguished as soon as the floor switchman restores the district selector to normal.

FINAL SELECTOR TIME ALARM PILOT LAMP

There is one pilot lamp with a white cap for all of the final frames on each floor. In the circuit there is a device for measuring off a pre-determined time interval which is long enough to allow the selector to perform its normal functions. If after the lapse of this interval the final selector does not become released, the pilot lamp is lighted indicating a stuck selector.

The desk switchman should understand by the lighting of this lamp that a final selector on the corresponding floor, indicated by the marking on the designation string is stuck, due to the receiver left off the hook or line trouble.

The pilot lamp is lighted usually only after the machine ringing had been tripped on the called connection.

The lamp is extinguished as soon as the floor switchman restores the final selector to normal.

LINE FINDER TIME ALARM PILOT LAMP

There is one lamp with a white cap for all the line finders on each floor.

By the lighting of this lamp the desk switchman should understand that a line finder trip circuit has failed to release. This lamp is extinguished as soon as the floor switchman restores the equipment to normal.

MOTOR STOP ALARM AND GUARD PILOT LAMPS

For each group of frames, that is, subscriber's sender, cordless "B" sender, line finder, district, office, incoming and final frames on each floor, there is one lamp with a red cap.

For the frames which are located on the same floor with the trouble desk there are two lamps, one with cap and a "push in" and "pull out" key for each motor on the floor.

Upon the lighting of the red lamp the desk switchman should understand that a motor has stopped.

As soon as the floor switchman pulls out the associated motor stop key at the floor alarm board or at the trouble desk, (if the motor is on the same floor with the latter) the red lamp is ex-

tinguished and the white guard lamp is lighted. This signal therefore indicates to the desk switchman that the floor switchman is taking care of the trouble. As soon as both the red and white lamps are lighted, the desk switchman should understand that the motor is again running. When both lamps are extinguished the desk switchman should understand that the floor switchman has pushed in the motor stop key.

If a motor on the same floor with the trouble desk stops, it is good practice, in order to save the time of the floor switchman, for the desk switchman to pull out the motor stop key, and from the marking on the designation strip advise the floor switchman over the loud speakers or verbally, of the particular frame on which the motor has stopped.

When the signals indicate that the motor is again running, the desk switchman should restore the key. When it appears that power drive trouble on incoming frames carrying the trunks from distant offices cannot be cleared promptly the desk switchman should notify the distant office desk switchman so that steps can be taken to stop using the trunks involved. As soon as the trouble is cleared the necessary instructions should be transmitted to have the trunks restored to service.

MAIN CHARGE AND DISCHARGE PILOTS LAMPS.

There is one lamp with a white lamp cap for the main charge fuse, and one lamp with a white cap for the main discharge fuse.

When lighted these lamps indicate to the desk switchman that these fuses are blown. They are extinguished as soon as the blown fuses are replaced by new fuses.

HIGH AND LOW BATTERY VOLTAGE PILOT LAMPS

Two lamps, each with a white cap, are provided to indicate when the battery voltage is more than fifty volts or less than forty five volts. These lamps go out again when the voltage becomes normal.

RINGING CURRENT VOLTAGE FAILURE PILOT LAMP.

Two lamps are provided, each with a white cap, one for indicating the failure of potential on the ringing generator bus bars. These lamps are extinguished as soon as the voltage is again within the prescribed limits.

CIRCUIT BREAKER PILOT LAMP.

One lamp with a white cap is provided for indicating the opening of the circuit breakers. It is extinguished as soon as the circuit breaker is closed.

PHASE FAILURE PILOT LAMP.

One lamp with a white cap is provided for indicating the failure of any one of the phase of the polyphase power source. It is extinguished as soon as the breakdown in the power source is removed.

CLOCK CIRCUIT PILOT LAMP

One lamp is provided with a white cap for indicating trouble on the clock circuit controlling the No. 1-A electric clocks. It is extinguished as soon as the trouble is removed.

AUTOMATIC ROUTINE TEST PILOT LAMP.

One lamp with a white cap is provided for each of the automatic routine tests. The lamp is lighted when the automatic routine test is blocked because of meeting trouble. When the switchman who watches the automatic routine test equipment, takes action, restores the equipment to normal or causes it to repeat its operation, the lamp is extinguished.

The desk switchman should advise the various switchman engaged in making routine tests, of any power failure or other disturbance which would be apt to affect the accuracy of the testing equipment.

CORDLESS "B" EMERGENCY SIGNAL.

One lamp with a white cap is provided for each cordless "B" position. The lamp is caused to be lighted by the operation of a key in the cordless B position by the "B" supervisor.

Upon the lighting of this lamp the desk switchman should understand that the cordless B position is out of service. He should at once send a switchman to the "B" position and one to the cordless "B" frames. From the nature of the reports of these men the desk switchman should determine whether or not the emergency key board should be employed and give instruction accordingly. The lamp is extinguished when the "B" supervisor restores the key to normal.

PERMANENT SIGNAL TRUNK

Description of Equipment:

The permanent signal trunks are intended to afford a means for holding subscriber's lines that have a permanent signal for a period of eight to ten minutes during which the howler is to be applied and for identifying the particular district selector as a first step in identifying subscriber's line.

P.B.X. lines are to be held on these trunks until the trouble is actually cleared. A group of these trunks extends from each district frame to the trouble desk, there being three trunks individual to each frame and two trunks common to a small group of frames. The individual trunks will be first in the order of preference. The equip-

ment at the trouble desk consists of a designation strip, a jack, a lamp with a white cap and a disconnect key.

Method of Operation:

If, after momentarily inserting the plug of a talking cord in the make busy jack after having answered a permanent signal or a partially dialed number signal on a subscriber's sender, the lamp of some one of the permanent signal trunks does not become lighted, the sender monitor should understand that the line had come clear. No further action need be taken in this case except to note on the permanent form the time the line came O.K.

If after momentarily inserting the plug of a talking cord in a make busy jack the lamp of some one of the permanent signal trunks flashes, the sender monitor should understand that the particular subscriber's line in trouble had been connected to this particular permanent signal trunk and that the trouble condition still exists on the line.

The sender monitor should answer by inserting the plug of the howler cord in the associated answering jack and operate the talking key. This act will cause the lamp to become steadily lighted and to remain so until the disconnect key associated with the permanent signal trunk is depressed, or until the trouble condition on the line is removed.

The talking key connects the sender monitor's telephone set to the line and he should challenge with the words "Repair clerk." If a response is received, the sender monitor should say, "The line is temporarily out of order, will you hang up and in a few moments dial again please."

The sender monitor should disconnect at once, and as soon as the permanent signal trunk lamp flickers understand that the subscriber has hung up, then depress the disconnect key and note the time the trouble came O K on the permanent signal form. If the lamp remains steadily lighted the sender monitor should understand that there is trouble on the line and should treat the case as a permanent signal as outlined in the following paragraphs.

If no response is obtained, the sender monitor should disconnect and note on the running permanent signal form provided for this purpose, the district frame number or numbers, and permanent signal trunk number, this information being obtained from the permanent signal trunk designation strip. The sender monitor should then advise a switchman by telephone of the permanent signal, giving to him the district frame number or numbers, and the permanent signal trunk number for the purpose of tracing the subscriber's line.

The information which the switchman reports, back regarding the subscriber's line should be entered in the proper columns on the permanent signal form.

This information will consist of the subscriber's number, if the line is a party line all of the other parties thereon, if the line is one of a P.B.X. group, the number of the first line of the group.

If the line is one of the P.B.X. group the sender monitor should verbally request the desk switchman to get in touch with the P.B.X. and request the P.B.X. operator to attempt to disconnect from the line in question.

If this removes the trouble condition from the line in question the permanent signal trunk lamp will flicker, giving a dis-

tinotive signal to the sender monitor that the line has become clear. The sender monitor should depress the disconnect key and note the time the line came O K in the proper column on the permanent signal form. If the trouble condition does not become removed from the line, the sender monitor should refer the case to the repair clerk and at the same time place a dummy plug in the answering jack.

On all lines other than P.B.X. lines, the sender monitor should hold the line for approximately eight to ten minutes, in which interval he should apply the howler at least twice. To apply the howler the sender monitor should insert the cord in the answering jack and operate the talking key and challenge on the line. This must be done each time before applying the howler. If no response is received, the howler should be operated. During the interval that the howler tone is connected to the line the howler cord supervisory lamp flickers, at other times when the lamp is not lighted, the sender monitor should understand that the receiver is off the hook, and that when it is lighted the receiver is on the hook.

During the interval that the permanent signal trunk lamp will remain steadily lighted unless the trouble condition on the line disappears in which event the lamp will flicker. The sender monitor should then depress the disconnect key. The line should be considered as having come clear and the time the line came O K should be noted on the permanent signal form.

As an exception, in those cases where a dummy plug is in an answering jack, the latter should not be disconnected except at the request of a local test man. This practice makes it possible to place a busy test on the third wire of those P.B.X. lines which are out of order and thus does not interfere with the hunting of lines of P.B.X.

at the final frames. However, when the lamp flickers the sender monitor should advise the local terminal of this act.

All P.B.X. lines on which the desk switchman has been unsuccessful in having the trouble condition removed and all other lines still in trouble after having been held eight to ten minutes, should be referred to the repair clerk. The sender monitor by telephone should give to the repair clerk the subscriber's numbers involved, if a P.B.X. line, the number of the first line of the P.B.X. group, the line finder terminal number, and the number of the assigned plugging up circuit.

The sender monitor should assign any idle plugging up circuit, the fact that it is idle being indicated by an unlighted green lamp which is associated with each plugging up circuit.

As soon as the frameman removes the heat coils for "putting up" the plugging up circuits, the subscriber's line will be opened, thereby, (unless the trouble is inside the office) causing the permanent signal trunk lamp to flicker. The sender monitor thereupon should depress the disconnect key.

When the sender monitor recognizes that the permanent signals are due to a cable failure or storm condition, without applying the howler he should report the cases to the repair clerk as fast as the tracer or switchmen report back the numbers of the subscriber's line. Plugging up circuits should be assigned as long as they are available.

OVERFLOW PERMANENT SIGNAL CIRCUIT

Description of Equipment

The overflow permanent signal circuit affords a means for indicating when a subscriber's line having a permanent signal has been

come connected to the overflow terminals of a permanent signal trunk group at one of the district frames, consequent upon the sender monitor momentarily inserting the plug of a talking cord in the make busy jack of the sender. It also affords a means, although somewhat less exact, for identifying the district selector involved in the connection.

The overflow terminals of all the district frames are multiplied together and whenever such terminals are seized by any district selector, a lamp located in the piling block in front of the sender monitor is lighted. A non-locking key is provided in association with this lamp for extinguishing it, each time it is lighted.

METHOD OF OPERATION

When the overflow signal lamp is lighted, consequent upon the sender monitor momentarily inserting the plug of a talking cord in the make busy jacks of the sender, he should observe which one of the permanent signal trunk groups had all five lamps lighted. From this he can infer what district frame or what group of frames is involved. As soon as this information is obtained, the key associated with the overflow permanent signal lamp should be operated to extinguish the lamp. The number of the district frame or frames should be noted on the permanent signal form, together with the fact that the line had become connected to an overflow terminal. This information should be given to the tracer by telephone for the purpose of tracing the subscriber's line. When the tracer reports back, the sender monitor should note the information on the permanent signal form and then forward this information by telephone to the repair clerk adding that the subscriber's line is connected to overflow.

The howler cannot be connected to subscriber's lines routed to overflow terminals but it is believed that this will not occur frequently.

Where the sender monitor recognizes that the permanent signals are due to a cable failure or storm condition he should report the cases to the repair clerk as fast as the tracer or switchman reports back the numbers of the subscriber's lines. Plugging up circuits should be assigned as long as they are available.

PLUGGING-UP CIRCUITS

Description of Equipment.

The plugging-up circuits are intended to afford a means for intercepting service on subscriber's lines out of order because of (1) receivers off the hook, short circuit or grounds, (2) opens and, (3) coin box lines, and for testing the subscriber's lines outside of the office. The circuit extends from the main frame to the trouble desk. At the main frame, the circuit is terminated in jacks located in jack boxes which are multiplied at intervals along the frame. By means of a fourway patching cord, connection is made between the jacks and the protector springs.

The circuit has two paths, one path connecting the final multiple to jacks at the trouble desk and the other path connecting the subscriber's line outside of the office to jacks at the trouble desk. The former is used for intercepting service, the latter is used for testing. For the former, the equipment at the trouble desk consists of a designation strip, a jack, and a lamp with white cap; for the latter, a lamp with green cap, a jack, a second lamp with a red cap and a transfer key. The lamp with a white cap is lighted whenever the subscriber whose line is "up" on the plugging-up circuit is called, the lamp being lighted through the operation of a ringing-up relay. The lamp with a green cap is lighted whenever a patching cord is connected to the jack boxes at the M.D.F. thus serving as a guard signal. The lamp with the red cap is responsive to conditions on the subscri-

ers line. Its lighting depends also upon the setting of the transfer key. Normally, when the transfer key is "pushed in" the circuit is set for troubles causing permanent signals, such as short circuit and grounds and when it is "pulled out" it is set for opens and coin box lines.

A separate group of plugging up circuits should be set aside for coin box lines discovered having grounds on the tip only as outlined under the heading "Subscriber's Sender Supervisory Equipment", the action which the sender monitor must take in response to the plugging up, circuit signals is different from that on regular subscribers lines.

METHOD OF OPERATION

When the green lamp of a plugging up circuit is lighted, the sender monitor should understand that the frameman had connected the plugging up circuit to a subscriber's line. This lamp will remain lighted as long as the patching cord at the M.D.F. is "up" thus serving as a guard signal.

If the white lamp is lighted, the sender monitor should insert a talking cord in the associated answering Jack, operate the talking key and challenge with the words "Repair Clerk, What number are you calling, please?" If no response is received on challenging, the sender monitor should operate the flashing key associated with the talking cord for the purpose of flashing in the distant operators that may be on toll or manual connection, and when an answer is received challenge with words, "Repair Clerk, What number are you calling, please?"

If the number given by the subscriber or operator does not correspond with any of the numbers opposite the plugging up circuit

number on the permanent signal form, the sender monitor should advise the calling party that he is connected to the wrong number and should call again. If the number given by the calling party is one of those on the permanent signal form the sender monitor should advise that the line is out of order. If any reasonable information can be furnished as to when the line will be restored to service, this should be given. If the line is temporarily transferred, the temporary number should be given to the calling party.

Having furnished the desired information, the sender monitor should disconnect. If after challenging at ten seconds intervals for one half minute, no response is received the sender monitor should disconnect.

When the sender monitor assigns a plugging up circuit for a line having a permanent signal she should see that the transfer key is in its "pushed in" position. When she assigns a plugging up circuit for a line having an open, he should see that the transfer key is in its pulled out position. When he assigns a plugging-up circuit from the group sets aside from coin box lines discovered as having grounds on the tip as outlined under "Supervisory Equipment" he should see that the transfer key is in its pulled out position. Occasionally in the latter case, there may be at the same time a short circuit or ground on the ring side of the line, in which event, the transfer key should be in its "pushed in" position.

If a red lamp lights or flashed on a plugging up circuit set aside for coin box lines only, the sender monitor should insert the plug of a talking cord in the associated answering jack, operate the talking key and challenge with the words, "Repair Clerk."

If a subscriber is on the line the sender monitor should say "There is some trouble on the line, will you use another telephone, please?" If the subscriber indicates that he had deposited a coin the sender monitor should say "The money should not be deposited until the dial tone is heard. Will you consult the instructions in the directory, please?" If the subscriber insists that he had deposited a coin the sender monitor should obtain his name and address and advise him that the amount due him will be mailed to his address. The sender monitor should disconnect immediately upon the lighting of the supervisory lamp.

If a Repairman is on the line he may say to the sender monitor that he is merely testing the line. In that event the sender monitor should disconnect immediately and for the time being pay no attention to the lighting of the red lamp. If the repairman wishes to be connected to the local test desk to have a test made, the sender should withdraw the talking cord and insert the plug of a test trunk from the local desk in the jack.

If a red lamp lights or flashes on a plugging up circuit other than those set aside for coin box lines, the sender monitor should insert the plug of the talking cord in the associated answering jack, operate the talking key and challenge with the words, "Repair" clerk."

If a subscriber is on the line the sender monitor should say "There is some trouble on the line, as soon as this is removed you will be called. Will you hang up, please?" Whether or not the supervisory lamp is lighted the sender monitor should disconnect at once and insert the plug of a test trunk from the local test desk in the jack.

TALKING TRUNKS

General:

The talking trunks afford a means for making the trouble desk a clearing house for transmitting and receiving reports and instructions relating to the machine switching equipment. They are key ended and are located in the Jack panels directly above the piling blocks.

On some keys there are two trunks and on others there are only one. The associated lamps are located either directly above or below the keys. Designation strips are provided in association with the lamps. Some of the talking trunks appear before both the desk switchman and the sender monitor and others appear in only one of these positions. The key used on those trunks requiring a holding position has three positions in the following sequence; normal, talking, holding. This sequence eliminates the possibility of giving a disconnect to the machine switching equipment in passing from "Talking" to "Holding."

Upon receiving over any of these trunks reports of central office equipment trouble applying to his own office the desk switchman should make out a trouble ticket.

TALKING TRUNK TO FINAL FRAME-DESK SWITCHMAN ONLY

The talking trunk to the final frame enables the outside maintenance forces to reach the desk switchman by dialing the assigned number. This should be cross-connected to line finder equipment, thereby enabling the desk switchman to make outgoing calls. They should not be listed in the directory, and should preferably be in the section of the final multiple reserved for official lines. Upon the lighting of the lamp, the desk switchman should answer by operat-

ing the key to its talking position. This causes the signal to be restored and the desk switchman's telephone set to be connected to the circuit. If the desk switchman disconnects first, the signal is not relighted.

If the desk switchman desired to hold the connection, he should operate the key to its holding position.

If the desk switchman wishes to call a number he should operate the key to its talking position and then operate the dial associated with the telephone circuit.

TALKING TRUNK TO OFFICIAL BOARD

Desk Switchman only

The two-way talking trunk to the official board enables the desk switchman to be reached direct from the official private branch exchange and to enable the desk switchman to reach any line through the P.B.X.

Upon the lighting of the lamp the desk switchman should operate the key to its talking position. The operation of the key extinguishes the lamp and connects the desk switchman's telephone set to the circuit. If the desk switchman wishes to hold the circuit, he should operate the key to its holding position.

If he should disconnect first, the lamp will remain extinguished.

If the desk switchman wishes to call one of the lines at the official P.B.X. or make a call through the P.B.X. he should operate the key to its talking position and when the P.B.X. operator answers, request connection to the desired line.

TALKING TRUNK TO SWITCHMAN'S STAND-DESK SWITCHMAN ONLY

Two-way talking trunks are provided between the switchman's stand and the trouble desk. In as much as the circuit does not require a holding position, two trunks are associated with each key.

Upon the lighting of the lamp the desk switchman should operate the key toward the lighted lamp, which act will extinguish the lamp and connect the desk switchman's telephone set to the circuits. Should the desk switchman disconnect first, the lamp will remain extinguished.

To call the switchman, the desk switchman should operate the key to its talking position and then operate the ringing key associated with the telephone circuit located in the row of keys above the piling block.

TALKING TRUNK TO LOCAL TEST DESK

Desk Switchman Only:

Two way talking trunks are provided between the local test desk and the trouble desk. Two trunks are associated with each key.

Upon lighting of the lamp the desk switchman should answer by operating the key toward the lighted lamp which act will extinguish the lamp and connect his telephone set to the circuit. Should he disconnect first, the lamp will remain extinguished.

To call the local testman, the desk switchman should merely operate the key.

TALKING TRUNK TO LOUD SPEAKERS

Desk Switchman only:

Trunks to local speakers are provided to enable the desk switchman to promptly "pick up" the floor switchman no matter in what part of the switchroom he may be. This means of communication en-

ables prompt instructions to be given in connection with the stoppage of motors, cordless "B" positions out of service, etc. Two trunks are associated with each key. Each trunk may have connected to it as many as four loud speaking receivers located in the different parts of the apparatus room on the various floors. Associated with the loud speaker there is a talk back transmitter so that two-way communication may be carried on with the floorswitch man from any part of the room.

Should the desk switchman wish to communicate with the floor switchman he should operate the key to its talking position which connects his telephone set to the circuit.

TALKING TRUNK TO SUPERVISORS

Desk Switchman Only:

Talking trunks to supervisors are provided to enable the supervisors at the cordless "B" board and "A" switchboard to report trouble relating to the machine switching equipment. Two trunks are associated with each key.

Upon the lighting of the lamp, the desk switchman should operate the key toward the lighted lamp. This act will connect his telephone set to the circuit and will extinguish the lamp. The lamp will remain extinguished should he disconnect first.

TALKING TRUNK TO DESKS IN OTHER OFFICES

Desk Switchman Only:

The talking trunks to desks in other offices are on a "code ring" basis, each office answering in response to its particular code ring. These trunks appear in the local test desk as well as the trouble desk and afford a quick means for communication between the offices on matters relating to inter-office trunk trouble, etc.

Upon hearing the code ring, the desk switchman should answer by operating the key to the talking position. If the desk switchman wishes to call some distant office, he should operate the key to its talking position and then operate the ringing key associated with the telephone circuit the requisite number of times to give the code ring.

TALKING TRUNK TO REPAIR CLERK SENDER MONITOR AND DESK SWITCHMAN

Talking trunks to the repair clerk enable the sender monitor and desk switchman to receive and transmit reports of trouble. Two trunks are associated with each key.

Upon the lighting of the lamp the desk switchman should answer by operating the key to its talking position. This act will extinguish the lamp and connect his telephone set to the circuit.

The lamp will remain extinguished should he disconnect first.

If he should wish to call the repair clerk, he should operate the key to its talking position.

TALKING TRUNK TO ZERO OPERATOR

Sender Monitor Only;

Two-way talking trunks to the zero operator are provided to enable the sender monitor to report cases of trouble where the subscriber is unable to obtain his connection and to enable the zero operator to report trouble which involves the machine switching equipment reported to her by subscribers. Two trunks are associated with each key.

Upon the lighting of the lamp the sender monitor should answer by operating the key towards the lighted lamp, which act will connect the sender monitor's telephone set to the circuit and cause the lamp to be extinguished. Should the sender monitor disconnect first, the lamp will remain extinguished.

If he should wish to call the zero operator he should operate the key to its talking position.

TALKING TRUNK TO LOCAL STATION - SENDER MONITOR AND DESK SWITCHMAN.

Two-way talking trunks are provided between local stations and the trouble desk to enable the desk switchman and members of the maintenance force to have communication from different parts of the building not otherwise covered by the trunks already described, such as in the restroom, power room, etc. A number of local stations may be connected to the same circuit in which event each one is called by a code ring. Two trunks are associated with each key.

Upon the lighting of the lamp the desk switchman should operate the key toward the lighted lamp, which act will connect the telephone set to the circuit and extinguish the lamp. If the sender monitor should disconnect first, the lamp will remain extinguished.

If the sender monitor wishes to call any of these stations, the talking key should be operated, and then the ringing key should be operated the requisite number of times to give the code ring.

TALKING TRUNK TO SUBSCRIBER'S SENDER FRAMES - SENDER MONITOR AND DESK SWITCHMAN

This trunk enables the sender monitor and desk switchman to have communication with the floor switchman working about these frames in connection with determining the states of any equipment thereon, or in connection with tracing trouble.

Two trunks are associated with each key. The circuit is one way from the frames.

Upon the lighting of the lamp the desk switchman should operate the key toward the lighted lamp, which act will connect the telephone set to the circuit and cause the lamp to be extinguished. If

the desk switchman should disconnect first the lamp will remain extinguished.

TALKING TRUNK TO CORDLESS "B" SENDER FRAMES - SENDER MONITOR AND DESK SWITCHMAN.

This trunk enables the floor switchman to communicate with the sender monitor or desk switchman and by means of an extension trunk routed by way of the assistant chief operators desk, to talk with the cordless "B" operators. The key has three positions in the following sequence: normal, talking and transfer. One trunk is associated with each key.

Upon the lighting of the lamp the desk switchman or sender monitor should operate the key to its talking position. This act will extinguish the lamp and connect his telephone set to the circuit. Should the desk switchman disconnect first, the lamp will remain extinguished.

Should the floor switchman wish to talk to a cordless "B" operator, the desk switchman should operate the key to its transfer position. He should then operate the key of the talking trunk to the assistant chief operator's desk and when the assistant chief operator answers instruct her to connect the extension cord at her desk into the desired Jack to the particular cordless "B" operator's headset. To have the circuit disconnected, the floor switchman should advise the desk switchman over one of the talking trunks from the switchman's stand. The desk switchman in turn should instruct the assistant chief operator to take down the extension cord at the assistant chief operator's desk.

TALKING TRUNK TO ASSISTANT CHIEF OPERATOR

SENDER MONITOR AND DESK SWITCHMAN

A two-way talking trunk is provided between the trouble desk and the assistant chief operator's desk.

Upon the lighting of the lamp, the desk switchman should operate the key towards the lighted lamp which act will extinguish the lamp and connect his telephone set to the circuit. Should he disconnect first the lamp will remain extinguished.

If he should wish to call the assistant chief operator he should operate the key to its talking position.

INCOMING CALL CIRCUIT SENDER MONITOR ONLY

An incoming call circuit from the local test desk is provided as a means for "ordering up" test trunks. If the sender monitor is busy by reason of the operation of any of the talking keys, the incoming call circuit will be disconnected from his head set and a tone connected thereto indicating to the testman that the sender monitor is busy. There is also associated with the circuit a lamp which is lighted when the circuit is taken by the testman at such time when the sender monitor is busy.

The sender monitor should understand upon the lighting of the lamp that as soon as practicable, all talking keys should be restored to normal, so that the communication from the testman may be received.

AUXILIARY PILOTS

Associated with all of the lamps at the trouble desk there are master pilots located in one panel. These master pilots are wired so that they light in synchronism with the lighting of certain groups of lamps in the trouble desk. There is one master pilot for each of the following:

All the alarm pilot lamps operating with the A.C. Alarm bell.

All the alarm pilot lamps operating with the D.C. alarm bell.

Motor Stop pilot lamps.

Motor guard pilot lamps.

Frame busy lamps

Selector line alarm pilot lamps

Subscriber's sender lamps

Cordless B sender lamps

Plugging up circuit lamps

Cordless "B" emergency signal.

Talking Trunk lamps and other miscellaneous lamp in the trouble desk.

These master pilot lamps serve to direct the attention of the sender monitor and desk switchman to the particular class of circuits involved.

Then by looking over the face of the trouble desk the particular lamp lighted can be found.

AUDIBLE AUXILIARY ALARM.

Associated with the lighting of all lamps an audible signal is also received either from a A C operated ringer or a D C operated gong, the more important alarms being connected to the latter. The latter is permanently connected in the circuits while the former may be disconnected by the operation of the auxiliary alarm key. The circuit is arranged, however, so that if the sender monitor should disconnect her head set from the telephone jacks the A C ringer circuit would be closed.

INTEROFFICE OUTGOING TRUNKS

All inter-office outgoing trunks, which in this case are all call indicator trunks, have their tip and ring conductors wired to a test jack located in the trouble desk in front of the desk switchman's position. There is also associated with this jack a make busy jack and a designation strip.

Should the desk switchman wish to test any inter-office trunk he should insert the plug of the selector test cord in this jack. If he wishes to remove the inter-office trunk from service he should do so by inserting a make busy plug in the make busy jack.

A sufficient number of make busy plugs should be kept on hand, these being stored away in the pigeon holes.

EMERGENCY SIGNAL CIRCUIT

In order to obtain the prompt attention of the maintenance force in case of the failure of the machine switching equipment, fire, etc. a single stroke gong system is provided throughout the switchroom under the control of a key located in the piling block of the trouble desk known as the emergency signal key. By means of this key, the desk switchman can send out code signals thus:- One signal meaning "all men come to the trouble desk;" two strokes, "fire" etc.

KEY SHELF EQUIPMENT

1- Talking Cord - Sender monitor - Description of Equipment

Talking cords are provided to enable the sender monitor to talk and supervise on subscriber's sender circuits and plugging up circuits. Each circuit consists of a cord and plug (no connections are completed), a supervisory lamp, a talking key, a flashing key, a coin return and coin collect key, and a coin pilot lamp which is located in the piling block. The circuit is arranged so that when answering on the interconnecting side of the plugging up circuit, no charge

will be made either on calls from machine switching or manual offices.

METHOD OF OPERATION

When the sender monitor inserts the talking cord in any of the circuits to answer a call, the supervisory lamp is extinguished if some one is on the line, otherwise it is lighted. To talk, the sender monitor should operate the talking key. When the talking cord is connected to the plugging up circuits and no one is found on the line, the sender monitor should endeavor to flash in the distant operator by means of the flashing key. When the talking cord is connected to the subscriber coin sender jacks, and if the sender monitor wishes to "collect" he should operate the "coin collect" key and observe the coin pilot lamp and if he should wish to "return" he should operate the "coin return" key and observe the coin pilot lamp.

SELECTOR TEST CORD

DESCRIPTION OF EQUIPMENT

By means of the selector test cord the desk switchman is enabled to test the trunk conductors and equipment of trunks leading to call indicator offices, he will also be enabled to make tests of Full Mechanical Interoffice Trunks. There is a set of numerical keys located in the keyshelf. There are seven strips of keys counting from the left as follows: Tandem, tens, tandem, units, thousands, hundreds, tens, units stations. The key in each of the first six strips of keys are mechanically locking and the depression of any one key automatically restores the key previously depressed.

On the station's strip of keys the stations keys "W", "Y", "R", and "J" together with the release key "O" are the only ones that are mechanically locking. The disconnect key (Disc) and the "start

keys F.M. Tan, and R.C. I on this strip are non-locking. The F. M. is the start key for calls completed to full mechanical offices. The R. C. I. key is the start key for calls completed to the manual offices.

There is one cord and plug with which is associated three lamps, one with a red cap, a second with a white cap, and a third with a green cap. The red lamp indicates whether or not the interoffice trunk is busy and in conjunction with the green lamp also indicates whether or not the distant selectors have gone to tell tale. The white lamp is supervisory lamp indicating when the call has been answered and when the receiver is replaced on the switchhook.

It also indicates when it flickers, that the distant selectors have gone to the overflow terminals. The green lamp flickers during the selection period. During the trunk closure and the ringing period following the green lamp is steadily lighted. A locking key is provided which enables the desk switchman to talk on the circuit. By means of the test key associated with the voltmeter test cord the desk switchman may connect the voltmeter testing combination to the selector test cord circuit.

To test the incoming selectors and R. C. I. equipment at the distant end of the inter-office trunks, the call may be routed to an attended station in the distant office - the trouble desk, or local test desk for instance - or the call routed to a special code number which is the same in all offices. In a full mechanical office this terminal on the final frame is wired to test permanently busy so as to transmit a "busy back flash" and in a R. C. I. office the number is connected to the busy back jack so as to transmit a "busy back flash."

METHOD OF OPERATION

To test, the desk switchman should insert the plug of the selector test cord in the test jack of the inter-office trunk. If the red lamp is not lighted the trunk is not busy. If the red lamp is lighted the desk switchman should understand that the trunk is busy.

By leaving the cord connected to the inter-office trunk, the moment that the trunk is free the red lamp should be extinguished. A preliminary voltmeter test should be made to determine that the trunk conductors are O.K. The desk switchman should then, assuming the call is to distant full mechanical office, set up the number on the numerical keys, commencing with the thousands digit, and then with the hundreds, tens and units. He should then depress the F. M. start key.

As soon as selection starts, the green lamp will flicker, should the green lamp flicker for an interval longer than ten seconds, the desk switchman should understand that the progress of the call had been blocked by equipment trouble of some kind. As soon as the green lamp changes from a flickering lamp to a steady lamp and the white lamp has become lighted, the desk switchman should understand that the trunk closure has taken place.

As soon as the desk switchman hears the ringing induction he should understand that ringing is taking place.

As soon as the distant test station answers, the white and green lamps are extinguished or as soon as connection is made to the special code number, the busy back flash is observed on the white lamp, the green lamp being extinguished. In both cases the desk switchman should understand that selection has properly taken place.

Where a distant attended test station has been called, the desk switchman can communicate with the party at the test station and

have him flash so as to determine from the lighting of the white lamp whether or not the supervisory equipment in the interoffice trunk is properly functioning.

Where the desk switchman encounters trouble on the distant machine switching equipment, he should make out a trouble ticket and by telephone give this information to the desk switchman at the distant office. He should then insert a make busy plug in the make busy jack. If necessary he should co-operate by means of his voltmeter test cord in assisting the inside man or switchman of the distant office in determining the nature of the trouble.

VOLTMETER TEST CORD

DESCRIPTION OF EQUIPMENT

The voltmeter test cord enables the desk switchman:

1. To determine the character and approximate location of short-circuit grounds and crosses.
2. To measure insulation resistance.
3. To measure capacity of cables and condensers.
4. To measure foreign potentials and currents.
5. To ring
6. To talk

The equipment and circuit arrangements are very similar to those provided for the local test desk No. 12 and consists of three lamps, one a supervisory lamp with white cap, a second, a busy lamp with a red cap, and a third a guard lamp with a green cap; of two cords with plugs, one at the sender monitor's position, and one at the desk switchman's position, and of the associated keys located in the

key shelf. The cord at the sender monitor's position is for use with the plugging up circuits and subscriber's senders and that at the desk switchman's position for use with the interoffice trunks. If the cord at the sender monitor's position through mistake is connected to a busy inter-office trunk, the tip and ring conductors will not be closed through.

METHOD OF OPERATION

If the desk switchman wishes to connect the voltmeter testing combination to the selector test cord, he should operate the test cord key (Test Cd.)

Should he wish to connect the voltmeter testing combination to the cord at the sender monitor's position, he should operate the sender monitor key (Sen. Mon.)

Assuming the desk switchman wishes to test an interoffice trunk, he should insert the plug of the voltmeter test cord in his position in the test jack of the inter-office trunk, and at the same time operate the make busy key (M.B.) which will cause the tip and ring conductors of the test circuit to be closed through if the trunk is not busy. If the trunk is busy under these circumstances the red lamp is lighted. Should he wish to test a busy trunk, he can disregard the busy condition on the sleeve by operating the no test key (No.T). The desk switchman should only use the keys, however, when he is certain that the inter-office trunk is otherwise out of service or if there is a make busy plug in the make busy jack.

The operation of the make busy key also causes the green lamp to become lighted and to remain lighted as long as the make busy key is operated.

The desk switchman should then make the necessary tests by the manipulation of the various keys.

If the desk switchman wishes to talk, he should operate the talk key (T-VM) which causes his telephone set to be associated with the test circuit and at the same time closes through the supervisory relays controlling the white lamps. When the desk switchman talks through the cord at his position or through the selector test cord, the supervisory circuit is arranged to be operated from battery and ground supplied at the distant end as for example, from the incoming selector. When the desk switchman talks over the cord at the sender monitors position as on subscriber's lines connected to plugging up circuits, battery and ground are supplied to the circuit in the standard manner through a 25-A repeating coil for furnishing talking battery and for energizing the supervisory relay. In either case when the white lamp is lighted, it indicates that the circuit is open and when the white lamp is not lighted, that the circuit is closed.

If the desk switchman should wish to ring a subscriber on a plugging up circuit, he should operate the ringing key (Ring.)

If the test shows that the trunk is in trouble, it should be removed from service by inserting a make busy plug in the make busy jack. This plug does not have to be removed to make tests either with the selector test cord or the voltmeter test cord.

HOWLER CORD

The howler cord enables the sender monitor to connect the graduated howler tone to a subscriber's for the purpose of attracting the subscriber's attention to the fact that he has left his receiver off the switchhook. By means of rotary switches under control of the howler key, the graduated howler tone is connected to the line. The howler tone goes through four cycles in approximately twenty seconds, when it is automatically disconnected. The circuit is arranged so

that the howler tone can be connected to the line only when it is at its minimum intensity.

The method of operation of this circuit is described under the heading "Permanent Signal Trunks."

TEST TRUNKS FROM LOCAL TEST DESK

Description of Equipment:

The test trunks from the local test desk are provided to enable the local test man to obtain access to the plugging up circuits and inter-office trunks for the purpose of making tests. These test trunks are located in both the sender monitor and desk switchman's position. The equipment consists of a cord with a plug and an associated disconnect lamp.

METHOD OF OPERATION

The sender monitor should "put up" a test trunk at the request of a local testman received by way of the incoming call circuit to the sender monitor's telephone set. The local testman will assign the test trunk to be used and will give the plugging up circuit number of inter-office trunk number. The test trunk should be taken down on the lighting of the disconnect lamp. Before a test trunk is connected to the test jack of an inter-office trunk, a make busy plug should be inserted in the make busy jack. The fact that a make busy plug is in the make busy jack does not interfere with the tests.

The sender monitor should also put up test trunks in response to the lighting of the red lamp of plugging up circuits as outlined under the heading "plugging up circuits."

TELEPHONE SET CIRCUITS

Desk Switchman's Position.

By operation of the keys of the talking trunks to the talking position, and by the operation of the talking keys of the test circuits, the telephone set is connected to these circuits. A dial located on the key shelf enables the desk switchman to make calls on the exchange talking trunks.

A ringing key is also provided which enables the desk switchman to ring on these talking trunks which are on a ring down basis. A secondary cutout key (Sec CO) is provided which cuts out the secondary winding of the induction coil thereby enabling the switchman to listen on circuits without interference from the transmitter. The telephone circuit is arranged so as to trip machine ringing and to minimize clicks.

Sender Monitor Position:

By the operation of the keys of the talking trunks and permanent signal trunks to the talking cord, the telephone set is connected to these circuits. A secondary cut out (Sec CO) is provided which cuts out the secondary winding of the induction coil thereby enabling the sender monitor to listen on circuits without any interference from the transmitter, when the sender monitor's position is vacated a contact on the operator's jack causes the AC alarm bell circuits to become closed. The circuit is arranged to trip machine ringing and to minimize clicks when answering and when flashing.

ELECTRIC CLOCK

A-1-a Electric clock is provided which enables the desk switchman and the sender monitor to have a means for timing the reporting and clearing of trouble on trouble tickets.

PLANT SCHOOL

SEATTLE WASHINGTON

PANEL MACHINE E QUIPMENT

LESSON NO. 23

SUBJECT

REPAIR CLERK DESK

LESSON NO. 23

GENERAL

The repair clerk in a machine switching office has practically the same functions to perform as regards receiving reports of trouble affecting the wire plant and noting it on the trouble cards as in a manually operated office and should, therefore, be governed in general by the instructions and routines covering a repair clerk's desk in a manual office.

DESCRIPTION OF EQUIPMENT

Briefly in the Repair Clerk's desk, there are provided:

- 1- Talking Trunks
- 2- A Telephone Circuit
- 3- A Talking Trunk Transfer Circuit
- 4- An Electric Clock

Talking Trunks are provided to the:

- 1- Final Frame (two way)
- 2- Zero Operator (two way)
- 3- Trouble Desk (two way)
- 4- District or Office Frame (incoming only)

OPERATION

In general the repair clerk will receive over the talking trunks to the repair clerk's desk all reports of trouble affecting the wire plant, both subscriber's lines and trunks, and should note such reports of trouble directly on the Trouble Cards provided for each circuit or unit of equipment. The repair clerk will receive reports of trouble from subscribers directly from Zero Operators, from

the trouble desk attendants in the same or distant offices, and from the repair clerks of other offices. All reports of trouble which appears to involve machine switching equipment should be forwarded by the repair clerk to the desk switchman of the office concerned.

When a subscriber reports that he is unable to get his party or that he gets wrong numbers, the repair clerk should attempt to ascertain whether the trouble is due to a defective dial, and should do so by asking such questions as: "Does the dial seem to work properly?" "Does it stick?" or "Are any parts badly bent or broken?" If a subscriber reports that the dial is not working properly, the repair clerk should attempt to ascertain whether or not it is some mechanical defect. After such information is obtained, it should be noted by some suitable code on the trouble card.

"Out-of-order" subscriber's lines having permanent signals are to be held at the trouble desk for a short interval during which an attempt is to be made by the sender monitor to have the receivers off the hook replaced through the use of the howler. Should the sender monitor fail, he will report the case to the repair clerk giving, among other information, the number of the plugging-up circuit to be used, which will be entered on the trouble card of the "Out of Order" subscriber's line. He will then pass the card to the test desk man who will have the assigned plugging-up circuit put on the particular "out of order" subscriber's line.

The talking trunks are key ended on keys of the lever type having three positions in the following sequence: normal, talking and holding. This sequence eliminates the possibility of giving a false

disconnect to the machine switching equipment in passing from the talking to the holding position on the talking trunks.

A lamp with a white cap is associated with each trunk.

The telephone circuit is provided with a dial which enables the repair clerk to make outgoing calls on the two-way talking trunks to the final frame to transmit reports of trouble to the repair clerks of other offices concerned and to be called by other offices. The subscribers will be instructed to dial the repair clerk by means of a code number (611). The talking trunks to the zero operators enable them to report such cases of trouble as are brought to their attention by subscribers. The trunks to the trouble desk enable the repair clerk to report to that desk such cases of trouble as appear to affect the machine switching equipment.

A ringing key is provided but will not be used. A flashing key is provided which enables the repair clerk to flash on the talking trunks to the zero operator or to the trouble desk.

A #1-A electric clock may be provided by means of which the repair clerk should time all reports of trouble.

When the repair clerk's desk is not occupied, as after closing hours, the transfer key should be operated, which transfers to the intercepting operator at the special "A" board certain of the talking trunks from the district frame.

A buzzer key is provided which, when operated, causes the buzzer to sound simultaneously with the lighting of any of the lamps associated with the talking trunks.

Upon the flickering of the lamps of a talking trunk, the repair clerk should operate the associated key to its talking position. This act will cause the lamp to be steadily lighted and to remain steadily lighted even if the repair clerk should disconnect first. If the repair clerk should wish to hold the talking trunk as in the case of those two-way talking trunks to the final frame, the key should be operated to its holding position. In order to disconnect, the key should be restored to its normal position. To make a call, the repair clerk should operate the key to its talking position, and if it is on a two-way trunk to the final frame, should dial the numbers desired. These two-way trunks to the final frame are cross-connected to a line relay circuit.

SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lesson.

- 1- What are the duties of the Repair Clerks?
- 2- Give a brief description of Repair Clerk's desk equipment. -4-
- 3- How should the repair clerk handle "Out of Order" subscriber's line?
- 4- How should he handle trouble, which seems to involve machine switching equipment?
- 5- How will subscribers be instructed to dial the Repair Clerk?

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Trade-Mark "Common-Sense" Reg.
Patented April 19, 1904
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NEW YORK, N. Y.

